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BIG MUDDY CREEK WATERSHED
Butler and Logan Counties, Kentucky

FINAL ENVIRONMENTAL IMPACT STATEMENT

Glen E. Murray, State Conservationist
Soil Conservation Service

Sponsoring Local Organizations

Butler County Conservation District
Morgantown, Kentucky 42261

North Logan County Conservation District
Russellville, Kentucky 42276

Big Muddy Creek Watershed Conservancy District
Morgantown, Kentucky 42261

August 1980

PREPARED BY

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
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June 1980

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USDA ENVIRONMENTAL IMPACT STATEMENT

BIG MUDDY CREEK WATERSHED PROJECT Butler and Logan Counties Kentucky

Prepared in Accordance with
Sec. 102(2)(c) of P.L. 91-190

Summary Sheet

- I. Final Report
- II. Soil Conservation Service
- III. Administrative
- IV. Description of Action - The 65,140-acre watershed project is located in Butler and Logan Counties, Kentucky, and includes the construction of a floodwater retarding structure, alteration of 17.5 miles of stream channel, and continued application of the current land treatment program. This is an intermittent stream modified in the 1920's. The purpose of this project is to provide watershed protection and to increase the agricultural potential of flood plain acreage through a reduction of recurrent floodwater and sediment damage.
- V. Summary of Environmental Impact and Adverse Environmental Effects - Implementation of the project is expected to have the following beneficial effects upon the environment: (a) reduction of average annual floodwater and sediment damage by 87 percent; (b) provision of increased net returns from agricultural activities on 3,371 acres of flood plain land; (c) a stretching of purchasing power and a concomitant increase in the standard of living; (d) provision of favorable conditions conducive to more widespread agricultural land usage within the watershed; (e) provision of additional habitat for waterfowl; (f) reduction of wildlife losses from flooding of 2,408 acres of land previously subject to perennial flooding; (g) provision of an additional 50 acres of fish habitat in the form of one flood retention reservoir and 70 acres of farm ponds.

Project implementation is expected to produce the following adverse impacts on the environment: (a) elimination of most of streamside vegetation within the area inundated as a result of construction of FRS 7, and temporary elimination of streamside vegetation where channel modification occurs; (b) alteration of vegetative succession patterns due to improved drainage patterns; (c) increase in probability of soil erosion during construction; (d) permanent alteration and/or elimination of terrestrial and aquatic ecological systems; (e) long-term loss of carrying capacity for wildlife; (f) permanent emigration of wildlife because of noise and human intrusion; (g) permanent loss of 963 acres of woodland to agricultural

cultivation; (h) loss of 2,408 acres of pasture and oldfield to increased cultivation; (i) decrease in the assimilative capacity of the stream as a result of the channel work, and the pollutional load will be carried farther downstream; (j) an overall degradation in water quality, including higher stream temperatures and lower DO values.

- VI. Alternatives considered, alone or in combination, were: (1) no project, (2) structural measures, and (3) nonstructural measures.
- VII. List of Federal, State and Local Agencies from which written comments have been received:
- U.S. Department of the Army (Corps of Engineers)
 - U.S. Department of Health, Education and Welfare
 - U.S. Department of the Interior
 - U.S. Department of Transportation
 - U.S. Environmental Protection Agency
 - Advisory Council on Historic Preservation
 - Kentucky Department for Natural Resources and Environmental Protection
 - Kentucky Department of Fish and Wildlife Resources
 - U.S. Department of Agriculture - Office of Equal Opportunity
- VIII. Draft statement transmitted to CEQ on August 1, 1975.

USDA SOIL CONSERVATION SERVICE
FINAL ENVIRONMENTAL IMPACT STATEMENT

for

The Big Muddy Creek Watershed Project
Butler and Logan Counties, Kentucky

Installation of this project constitutes an administrative action. Federal assistance will be provided under P.L. 566, 83rd Congress, 68 Stat. 666, as amended.

SPONSORING LOCAL ORGANIZATIONS

Butler County and North Logan County Conservation
Districts and the Big Muddy Creek Watershed
Conservancy District

GENERAL

All information and data in this report, except as otherwise noted, were collected during the environmental assessment in 1974. The long lag time between the draft and the final environmental impact statement was due to resolving issues raised by Kentucky Department of Fish and Wildlife Resources and United States Department of Interior concerning impacts on fish and riparian habitat along the planned channel modification. These issues have been resolved and are reflected in the section on Structural Measures on page 3 of this report.

PROJECT PURPOSES

The project is designed to provide watershed protection and to increase the agricultural potential of flood plain acreage by reducing recurrent damages from floodwater and sedimentation.

Watershed Protection

The goal of the land treatment program is to reduce erosion, improve drainage characteristics, and administer beneficial soil conservation and land use management techniques. It is intended that land treatment measures such as conservation cropping systems, vegetated waterways, diversion ditches, and open and closed drains will afford landowners in the flood plain area with the protection required to enhance the agricultural potential of the region. Additionally, it is intended that increased agricultural productivity and wise land use management practices will generate increased yields and earnings for the landowners, which would consequently provide them with the purchasing power necessary to raise their standard of living and generally enhance the socioeconomic well-being of the watershed region.

Flood Prevention

The floodwater retarding structure and channel modification will provide protection from flooding, erosion and sedimentation downstream of the structures. They will confine runoff from the equivalent 5-year frequency storms in the stream banks and successfully abate damage from the 50-year frequency storms on 1,497 acres.

PLANNED PROJECT

Land Treatment Measures

An important element in the watershed project is land treatment measures. The Soil Conservation Service (SCS) provides technical assistance to individual farmers, administering a particular course of action in response to the specific problems confronting each landowner in the watershed. Technical assistance is provided at the request of individual landowners, and in cooperative agreement with the respective conservation districts. The SCS assists the landowner in tailoring a basic soil and water conservation plan for his land on the basis of soil surveys, land capability, and the farmer's individual land use requirement. Technical assistance for forestry measures is provided by the Kentucky Division of Forestry in cooperation with the Forest Service. The overall land treatment measures consist of the following:

Cropland	4,000 acres of conservation cropping, 400 acres of strip cropping systems, 1,540 acres of contour farming, 3,300 acres of cover and green manure crops, 430 acres of plow planting, and 4,500 acres of crop residue use.
Grassland	Renovation of 4,400 acres of grassland, hayland plantings (790 acres), and pasture plantings (6,000 acres).
Forestland	Tree planting on 250 acres, timber stand improvement on 250 acres, harvest cutting on 750 acres, and woodland grazing control on 1,000 acres.
Wildlife Habitat	Development of 15 acres
Mechanical Practices	Systems of grass waterways (140 acres), surface field ditches (18,560 feet), mains and laterals (30,855 feet), diversions (52,800 feet), gradient terraces (10,560 feet), drainage tiles (60,276 feet), 9,800 feet of pipeline for livestock, 650 acres of drainage, 80 farm ponds, 40 troughs and tanks, and 20 spring developments.

Planned land treatment practices have been implemented on 72 percent of the cropland, on 85 percent of the grassland, on 90 percent of the forestland, and on 100 percent of the wildlife habitat. The percentage of planned mechanical practices completed to date varies from 15 percent for diversions to 80 to 90 percent for pasture planting and critical area and minimal tillage.

Structural Measures

Five floodwater retarding structures (FRS) and 17.5 miles of channel modifications constitute another important element of the overall watershed project (Appendix B). Four structures (FRS 1, 2, 3, and 4) have already been completed. No channel work has been accomplished.

FRS 7, a single-purpose earthfill dam (Figure 1), has not yet been constructed. The maximum height of the dam will be approximately 35 feet. The emergency spillway will be cut in earth, and the principal spillway will be a 36-inch reinforced concrete pipe with a two-stage covered inlet. FRS 7 will require approximately 164 acres of land; of this, the sediment pool will require 50 acres and the floodwater pool 110 acres; 4 acres will be required for the dam and spillways.

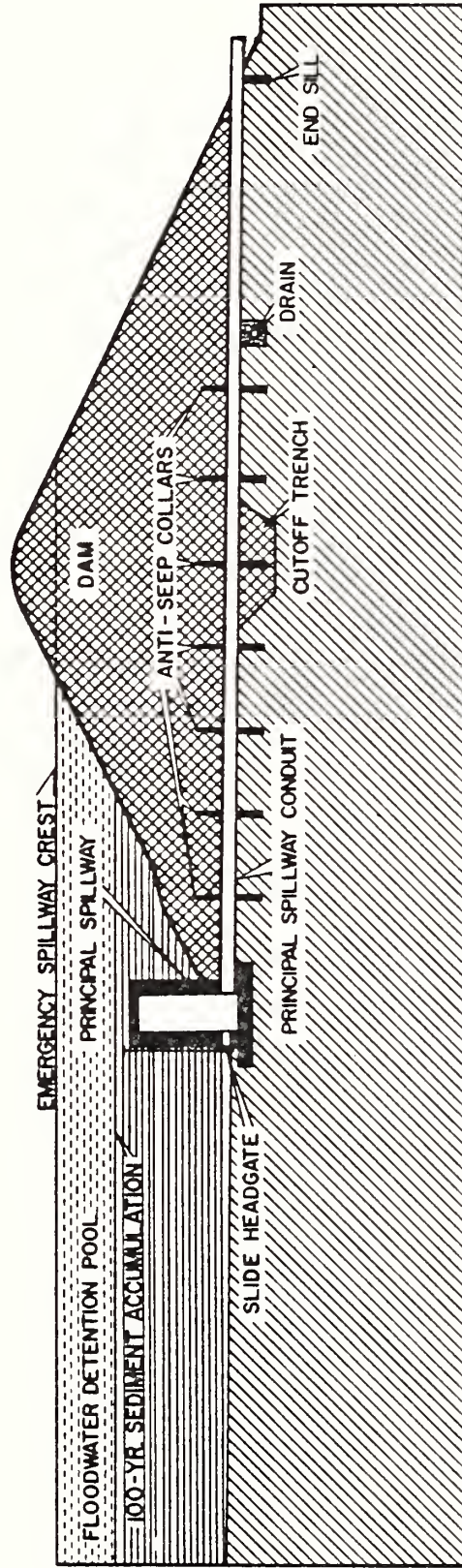
The structure is classified as a class "a." A recent reconnaissance of the site and downstream from the site revealed no changes had occurred that would affect the class of structure as determined during development of the work plan. In the event of a sudden breach there would be no loss of life or severe damage to property. The potential for development in the effected area below the structure is low.

The channel will be enlarged from points K to D and points A to G, a distance of approximately ten miles. It will be designed to provide a 5-year level of protection. Bottom widths of the channel will vary from 116 at point K down to 10 feet upstream at point D (See Appendix B). The constructed side slopes will be $2\frac{1}{2}$:1. The channel design is based on a gradient ranging from .088 to .022 percent.

The channel will be constructed with a two foot deep V shaped bottom. See figure 2 for a typical cross-section.

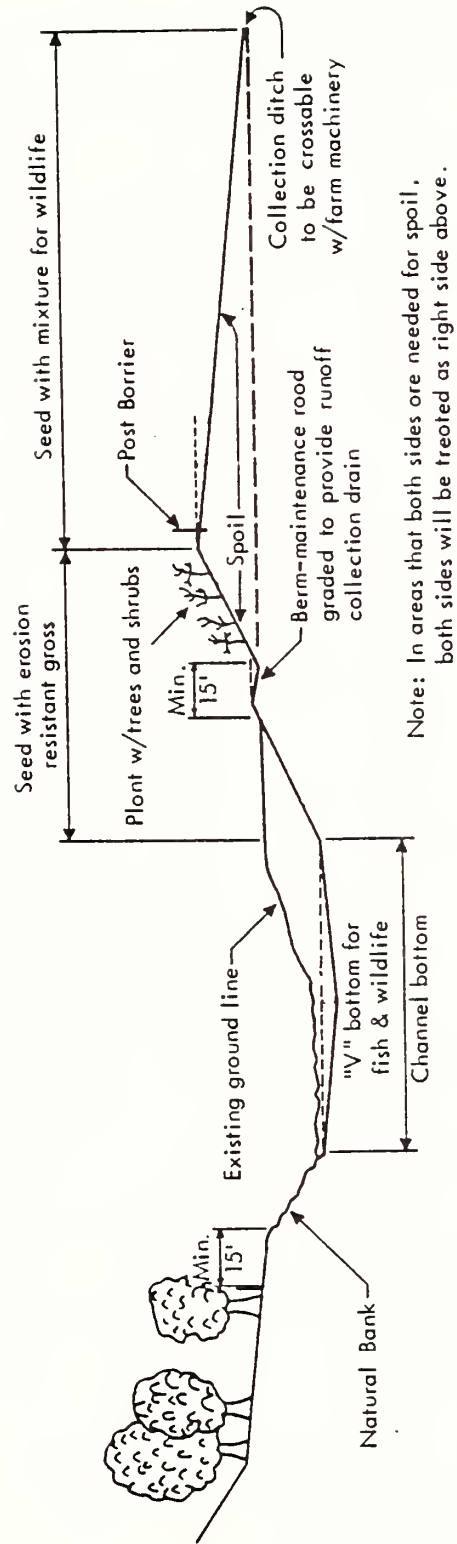
A riprap riffle structure will be installed at about 600 feet intervals over the entire ten miles, with a large boulder in the V section every 100 feet. All construction will be from one side with the existing shade left undisturbed on West-Southwest side of the channel to the maximum extent possible. Spoil will be piled, rather than spread, in wooded areas to reduce the area to be cleared. The front side of the spoil area will be planted to plants and shrubs having value to wildlife. Trees will be planted along the top of the streambank to establish woody growth for wildlife habitat.

In areas where clearing occurs a wooded buffer strip will be established extending 50 feet landward from the maintenance road on the disturbed side of the new channel. Maintenance will be performed from the disturbed side to the extent practical, but if necessary will be performed from the undisturbed side. Prior to construction, the necessary easements will be obtained to provide for maintenance.



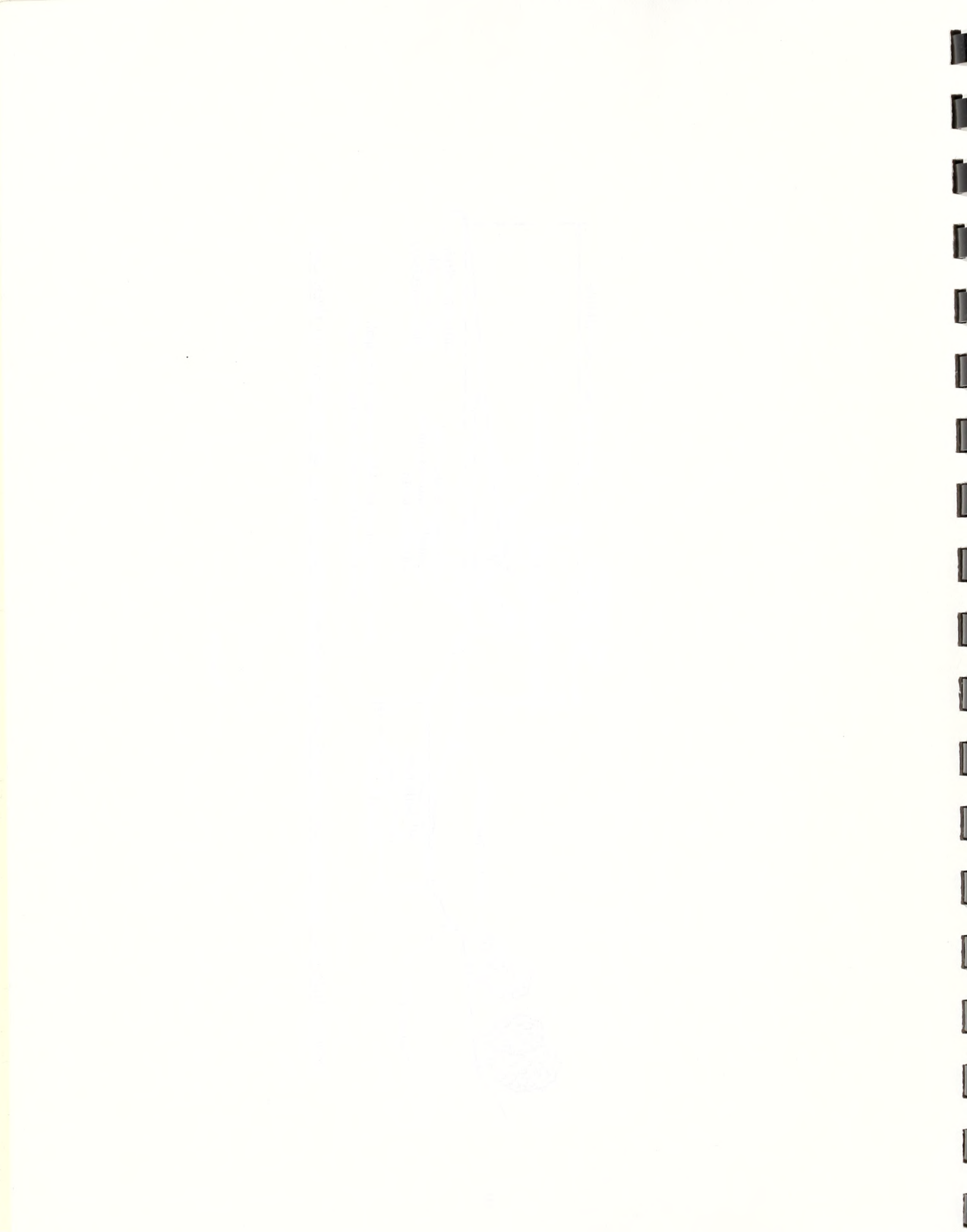
SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

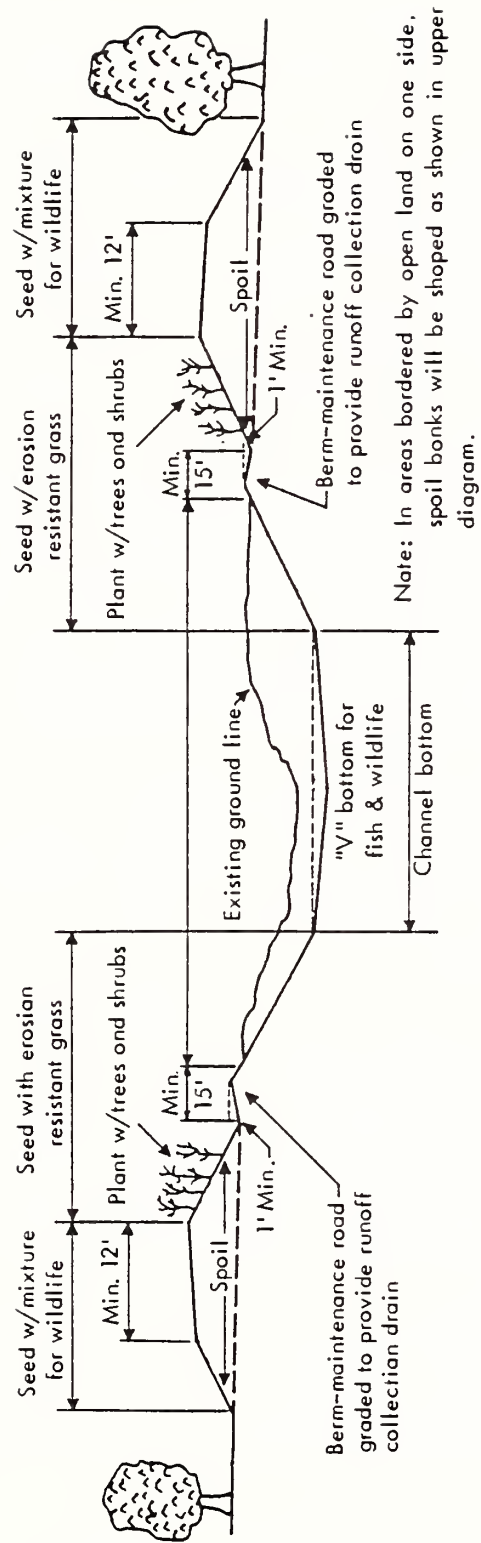
U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE



TYPICAL CHANNEL CROSS-SECTION SHOWING EXCAVATION AND SPOIL ON ONE SIDE ADJACENT TO OPEN LAND

Figure 2





TYPICAL CHANNEL SECTION SHOWING SPOIL ON BOTH SIDES AND ADJACENT TO WOODS

Figure 3

The buffer strip will be revegetated on the disturbed side of the new channel with trees on ten-foot centers (10x10-foot spacing).

Constructed channels will be through a low-plastic, fine grained soil. Channel velocity is controlled and sharp curves and areas above and below each bridge will be riprapped as necessary to obtain a stable channel. All channels will be vegetated immediately after construction.

The channel is designed to be stable in its as-built condition. Disturbed areas are to be vegetated and revegetated as needed to assure that an adequate vegetative cover is established within a 3-year period.

From point K downstream to Green River, a distance of approximately 7.5 miles, the existing channel will be cleaned by removing debris, sediment bars, etc., only to the minimum needed to provide a positive outlet for low flow in the channel. There will be a transition zone in the vicinity of point K.

All construction will be done in a manner to minimize soil erosion, sediment yield, and water and air pollution. This will include such measures as daily seeding of disturbed areas; keeping sediment within the construction area through the use of sediment basins or barriers; seeding access roads; sprinkling work area with water for dust abatement; controlling burning in accordance with federal and state air pollution laws and regulations; using onsite sanitary facilities that meet federal, state, and local requirements; and controlling excessive noise. All applicable safety regulations will be followed.

Installation of the structural measures will not result in any known displacement of any person, business, or farm operation. However, if relocations become necessary, the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646) will be used to minimize the inconvenience brought about by relocations.

Operation and Maintenance

Land treatment measures will be operated and maintained by the owners and operators of the land on which such measures are installed; this operation and maintenance will be under cooperative agreement, with the appropriate sponsoring conservation district. The SCS will provide technical assistance for agricultural land treatment measures; the Kentucky Division of Forestry, in cooperation with the Forest Service, will provide technical assistance for forestland treatment measures.

The Sponsoring Local Organizations will be responsible for, and will direct the operation and maintenance of the structural measures (five FRS's and 17.5 miles of stream channel modification). The Big Muddy Creek Watershed Conservancy District will maintain these improvements with funds obtained by the annual levied tax. The estimated annual

cost will be \$1,000 for the FRS's and \$5,400 for stream channel modification, or \$6,400 total. Prior to construction of each remaining structural measure, an agreement will be executed between the Big Muddy Creek Watershed Conservancy District and the SCS for its operation and maintenance.

A representative of the SCS and of the Sponsors will make joint inspections annually and/or after severe storms during a 3-year period following construction. This will determine how the measures are functioning, what maintenance is needed, when and how such maintenance will be performed, and an estimated cost. Similar inspections will be made annually and/or after severe storms by the Sponsors after the establishment period.

Maintenance may include such items as:

1. Revegetating areas affected by erosion
2. Controlling undesirable species of trees and shrubs
3. Fertilizing to maintain protective vegetation
4. Mowing grass as needed
5. Removing sediment bars and debris
6. Replacing or extending riprap where erosion has occurred
7. Maintaining access roads and any other parts of the structural works necessary for their safety and function, and other work as needed

Project Cost

Total watershed project cost is estimated at \$4,051,200, of which \$3,218,000 is P.L. 566 and \$833,200 is other. Total estimated project construction cost is \$2,947,300, which will be borne by P.L. 566 funds. The construction cost for measures remaining to be constructed, i.e., FRS 7 and 17.5 miles of channel modification is \$2,374,000. The total cost for remaining measures is \$2,744,900 of which \$2,621,150 will be funded under P.L. 566 and \$123,750 will be provided by local sources.

ENVIRONMENTAL SETTING

Physical Resources

The Big Muddy Creek Watershed is a 65,140 acre area of which 45,300 acres are in Butler County and 19,810 acres are in Logan County. It is situated within two physiographic regions - the Western Coal Field and the Mississippian Plateau (western Pennyroyal). The Pottsville Escarpment, which forms the boundary between these two regions, traverses the watershed in an east-west direction (Kentucky Geological Survey, 1954).

The Watershed, and the region contiguous to the watershed, displays a gentle regional dip toward the Western Coal Field structural basin. The upper reaches of the watershed are underlain by the Glen Dean Limestone Formation and the Leitchfield Formation, Chester Series, which are of Upper Mississippian age. Tradewater Formation, Pottsville Series, of Lower Pennsylvanian age underlies the lower reaches of the watershed. Outcroppings occur on steep slopes, in road cuts, and in upper stream reaches.

There are two normal discontinuous east-west trending faults approximately 2 miles south of State Route 70. The southernmost fault traverses the Sandy Creek valley, while the other fault traverses both the Sandy Creek and Big Muddy Creek valleys and is visible where it crosses Big Muddy Creek.

Topographic relief is in response to the underlying lithology. Elevations in the watershed range from a high of 735 feet along the central sector of the western divide to a low of 390 feet at the confluence of Big Muddy Creek with the Green River. The upper reaches are underlain by more erodible limestones and are characterized by wide flat ridges, broad gentle slopes, and moderately narrow valleys that approach a V-shaped configuration. Sandstone and shale have influenced the development of topographic features in the middle and lower reaches of the watershed. These reaches characteristically consist of long narrow ridges whose steep slopes terminate abruptly in wide alluvial flood plains. In the lower reaches, recent alluvial deposits range from 10 to 30 feet deep and consist of sand, silt, and clay materials in various combinations.

The watershed exhibits a dendritic drainage pattern, which is in response to local geology and the regional structural basin.

There are four general soil associations in the 65,140-acre watershed: The Zanesville-Frondorf Association, the Zanesville-Christian-Caneyville Association, the Talbott-Colbert Association, and the Newark-Nolin-Lawrence Association.

The Zanesville-Frondorf Association is composed of moderately deep-to-shallow, well-to-moderately well drained upland soils. These soils are found on steep side slopes and on broad ridge tops dissected by small drains. Zanesville soils are located on the ridge tops, whereas Frondorf soils occur on the steep side slopes. The Zanesville-Christian-Caneyville Association is composed of moderately deep-to-shallow, well drained upland soils; these are found on gently-to-steeply sloping topography. They were derived from limestone, sandstone, and shale origin.

The Talbot-Colbert Association consists of deep-to-shallow, well-to-moderately well drained argillaceous limestone soils located on gently sloping ridge tops and on steep side slopes.

The Newark-Nolin-Lawrence Association is composed of nearly level bottom and terrace soils that are characteristically deep and well drained to somewhat poorly drained. These soils were formed from alluvium derived from limestone and shale parent material. Because

most of the vegetation to be affected by the project region lies within the Newark-Nolin-Lawrence Association, a detailed description of this soil association follows.

1. Newark Soil Series. These consist of nonacid, somewhat poorly drained soils that formed in mixed sediment, dominantly of limestone origin. They have a brown silt loam surface, mottled upper B subsoil, and a grayish mottled silt loam lower B horizon. These soils occupy long, narrow, low flats with slopes averaging 0 to 3 percent. Newark soils have a moderate natural fertility and a high-to-very high moisture supply capacity. Roots and water easily penetrate the soils, but a seasonal high water table impeded root growth if adequate drainage is not provided. If adequately drained, these soils can be cultivated intensively and will produce better-than-average yields of summer crops such as soybeans, corn and milo. In addition, the Newark series is excellent for trees and for pastures consisting of water-tolerant grasses and legumes.
2. Nolin Soil Series. Nolin soils are deep, well drained bottomlands with a brown silt loam surface and dark yellowish B horizon. This series maintains moderate permeability while often subjected to flooding. A slope of 0 to 4 percent also is characteristic of Nolin soils.
3. Lawrence Soil Series. Lawrence soils are deep, poorly drained, acid soils situated on stream terraces. These soils have a pale brown silt loam surface with a light yellowish brown mottled upper B horizon underlain by a light yellow-brown mottled silt loam pan. Lawrence soils are characterized by a 0 to 6 percent slope, moderate permeability, and are subjected to seasonal flooding and ponding.

Big Muddy Creek Watershed lies within the 163,300-square-mile Ohio River basin and, more specifically, within the 9,230-square-mile Green River basin. The Green River empties into the Ohio at Ohio River Mile 784.2, approximately 8 miles east of Evansville, Indiana. The Green River is in Water Resources Subregion 07 of the Ohio River Water Resource Region as delineated by the U.S. Water Resources Council.

Big Muddy Creek originates in north-central Logan County about 1.7 miles ENE of Homer, Kentucky, and flows northward to its confluence with the Green River near Mining City, Kentucky, a distance of about 23.5 stream miles. It is joined by a number of small tributaries, including Brushy Fall, Flatrock Branch, Duncan and Dallam Creeks, Grassy Lock Creek, Sandy Creek, and Persimmon Creek. The main stem was channelized in 1929 to improve drainage in the lower basin for agricultural purposes, thereby shortening the stream some 10 to 15 miles. The stream descends from about 645 feet above mean sea level at its source to about 390 feet above mean sea level at its mouth--an average gradient of about 10.8 feet per mile. The gradient of the

upland portion of Big Muddy Creek (about 8 stream miles) is approximately 25.5 feet per mile; the flood plain portion has an average gradient of about 2.3 feet per mile. The lower basin is subject to periodic flooding.

The average annual rainfall in the area is 47.55 inches and is divided as follows: spring, 12.83 inches; summer, 11.64 inches; autumn, 9.32 inches; and winter, 13.76 inches. Total precipitation during the growing season is about 22.14 inches; high frequency, short duration rains occur more often during this period. The growing season is approximately 194 days, extending from about April 12 to October 23. The mean temperature is 37.4°F in January and 78.6°F in July, with a minimum and maximum of -22° and 108°F, respectively.

Big Muddy Creek is an ungaged watershed. The only official flow record is a U.S.G.S. reading of 0.46 cfs on August 28, 1973, which was taken as part of a water quality sampling program (U.S. Geological Survey, unpublished). Because of this lack of data, the present and future hydrologic conditions of the watershed were determined by examining such factors as soils topography, present and future land uses and cover conditions. A 5-year flood discharge of 6,227 cfs for Big Muddy was calculated.

Values of Big Muddy Creek Watershed streams for most parameters were within the norms given by various authors for unpolluted streams.¹ Big Muddy Creek and Duncan Creek are moderately hard, as defined by Sawyer and McCarty (1967), ranging from 105 to 188 mg/l total hardness. Johnson and Stapleton (1961) identify streams in Kentucky as being for the most part of the calcium carbonate type; they contain minor concentrations of such ions as magnesium, sodium sulphate, and chloride. Johnson and Stapleton further state that "some acidic water, caused from coal mine drainage exists in the eastern and western coal field regions; these waters run relatively high in sulphate, manganese and iron." Total dissolved solids ranged from 112 to 224 mg/l. Johnson and Stapleton (1961) give average TDS values for Kentucky surface waters as 70 to 225 parts per million (mg/l).

Specific conductance values obtained for Big Muddy Creek and Duncan Creek (170 to 360 micromhos/cm) indicate the presence of a moderate amount of minerals and moderate hardness; the values fall within a range indicative of an unpolluted freshwater ecosystem (Ellis et al., 1946).

The pH was similar at all sampling stations (7.4 to 7.5) and was well within the acceptable range of limits set by the state.

Dissolved oxygen did not indicate a high biochemical oxygen demand (BOD), except at Station 1-A of Appendix D-1, which had a rather low DO value. This possibly can be attributed to sawdust entering the creek

¹A water quality sampling program was conducted in August 1974; data from this survey were used in the preparation of this section. Survey data are presented in Table 1.

from a sawmill at the Kentucky Highway 70 bridge. Station 1-A was the only station at which the DO value was lower than standards set by the state of Kentucky.

The maximum coliform bacteria was 1,450 (per 100 ml) at Station 2-A; this is well below the maximum allowable limit of 5,000 set by the state.

Because residual pesticides and other toxic materials may be released when stream beds are altered, it is important to know the concentrations of these substances in the sediments to be dredged. The chlorinated hydrocarbon pesticides (DDT, DDE, Aldrin, Dieldrin, etc.) are especially resistant to biological degradation and may persist for months or years following application (Sawyer and McCarty, 1967).

Core samples of the top 18 inches of sediment were taken at three aquatic sampling stations on Big Muddy Creek. The samples were then analyzed by Analytical Bio-Chemistry Laboratories, Incorporated, Columbia, Missouri, for residual pesticides (Table 2). The analyses determined the absence of significant concentrations of pesticides in all samples taken at the three stations on Big Muddy Creek.

Ground water resources within the watershed of Big Muddy Creek are directly related to the bedrock geology. The watershed located within Logan County, and most of the watershed with Butler County south of Point L (see Project Map, Appendix B) is underlain by sandstone, limestone, and some shale strata belonging to the Chester Series of Upper Mississippian Age. These strata are all situated within the Mississippian Plateau Physiographic Region and generally yield enough water for modern domestic supplies to wells that have a capacity of 100 to 500 gallons per day (gpd). Most drilled wells encounter an adequate yield (more than 500 gpd) at depths less than 300 feet. Some wells that penetrate solution channels in limestone strata may be pumped at a rate of several thousand gallons per day; however, most of the ground water is produced from sandstone strata situated near the level of perennial streams. Dug wells penetrating Upper Mississippian sandstone strata generally yield more than 100 gpd in flood plain areas adjacent to streams or in broad upland areas. Near bluffs and escarpments, shallow ground water development is limited to containment of contact springs, but the supply is small and undependable.

North of Point L on the Project Map, the watershed enters a region occupied by Lower Pennsylvanian strata of the Western Coal Field Physiographic Region. The basal unit is the Caseyville Sandstone Formation. Wells drilled into the Caseyville Sandstone usually have no difficulty obtaining more than 500 gpd at depths less than 300 feet; yields up to 60 gallons per minute have been reported. The overlying Tradewater Formation contains alternating beds of shale, sandstone, and coal. Adequate ground water supplies are usually available to drilled wells that penetrate the sandstone members, although the shale members yield practically no ground water. Sandstone members of the Tradewater Formation usually yield more than 500 gpd, but the water may become highly mineralized in wells drilled deeper than 300 feet.

The study area (Big Muddy Creek Watershed), which includes Butler and Logan Counties, is primarily characterized by its commercial forest acreage and by diverse agricultural activities. In 1962, the 65,140-acre Big Muddy Creek Watershed contained approximately 21,149 acres (32 percent) of forestland, 20,367 acres (31 percent) of pastureland, 15,918 acres (26 percent) of cropland, and 6,706 acres (11 percent) of land that was idle or in miscellaneous use. An enumeration of Butler and Logan Counties land use data collected during a 1970 statewide inventory of soil and water needs by the State Conservation Needs Inventory Committee is presented in Table 3. In a survey conducted by Dames & Moore (1974) of 20 percent of watershed residents, 32 percent of the aggregate acreage was in pasture, 30 percent in crops, 20 percent in forest, and 16 percent was idle.

The ensuing paragraphs broadly discuss each of the land uses in Butler and Logan Counties.

Cropland - The principal cash crops grown in the two-county study area are corn, wheat, soybeans, hay, and tobacco. Table 4 gives the acreage and yield for each of these crops in 1964 and 1969.

Pasture - In 1967, 13 percent of the total land area of Butler County was in pasture. In the same year, 80,164 acres (23 percent) of pastureland were inventoried in Logan County. This represents a substantial increase since 1958 for both counties (see Table 3). Correspondingly, there was an increase in the number of grazing animals (cattle, sheep, and horses) in Butler County, while in Logan County, there was an absolute decline in the number of grazing animals.

Forest - This is the primary land use in the both counties in terms of total acreage involved. Forestland occupies 47.6 percent of Butler County and 30.3 percent of Logan County. The Kentucky Division of Forestry (1974) has compiled the following data with respect to the forest areas in Butler and Logan Counties:

	Total	All	Commercial	Best	% Commercial
County	Land Area	Forest	Forest	Hardwoods	Forest of Land Area
Butler	283,500	135,500	134,900	96,900	47.6
Logan	360,300	109,700	109,300	81,700	30.3

The forest stands consist entirely of hardwoods; white oak, Northern red oak, black oak, post oak and hickory are the predominant species

Urban and Built-up - Russellville (in Logan County), with a population of 6,456, is the largest community within the study area and is the only community considered to be an urban place (see Table 5). Russellville represents the largest

concentration of commercial land use. Smaller communities such as Morgantown, Auburn, Adairville, and Lewisburg also possess areas of commercial land use, but they are generally considered to be local centers catering to the needs of residents adjacent to the community.

Although Russellville and Morgantown are the primary centers for retail activities, a sampling of residents within the Big Muddy Creek Watershed indicated that approximately 73 percent of these residents traveled to Bowling Green to obtain a greater variety of goods and services (Dames & Moore, 1974).

Other Land - Other elements in the overall pattern of land utilization in the study area are industrial and mining activities and transportation networks.

1. Industrial Land - Industrial land uses in Butler and Logan Counties are located primarily either within the principal centers of population or in the fringe area peripheral to these centers. However, there are a few industrial facilities, such as saw mills and mining operations, scattered throughout the study area. Tables 6 and 7 show the number of firms reporting their operation in various categories of industrial activity in Butler and Logan Counties for the period 1967 and 1972.

1972 County Business Patterns (U.S. Bureau of the Census, 1973) listed only one company with more than 500 employees in Logan County (not in the study area); there were no companies with more than 500 employees in Butler County.

2. Mining Land - Mining activities are not uncommon to the overall pattern of land use in western Kentucky, for the watershed lies on the southern edge of the western Kentucky coal field (Thomas, Conkling, and Yeates, 1968). The principal mineral resources in Butler County are coal, limestone, and petroleum; other mineral resources include clay, clay shales, rock asphalt, and sand (Kentucky Department of Commerce, 1971). In Logan County, limestone and petroleum are the principal mineral resources; natural gas, rock asphalt, silica sand, coal, and clays occur but are not considered commercially significant (Kentucky Department of Commerce, 1972). The 1967 Census of Mineral Industries listed nine mining companies operating in Butler County and two in Logan County (U.S. Bureau of the Census, 1973). Currently, there are a few small strip mining operations in the northern section of the watershed.

3. Transportation Networks - Highways afford the principal means for transportation within the study area. On a regional basis, the Green River Parkway, a north-south-trending toll road, provides excellent access to Bowling Green, Owensboro, and other major highways such as the Western Kentucky Parkway and Interstate 65. Primary local highways are U.S. 231 (which parallels the Green River Parkway), U.S. 431, and U.S. 68. Other principal roads are S.R. 79 and S.R. 70.

The Louisville & Nashville Railroad provides a variety of services to residents of Logan County and directly serves Auburn, Lewisburg, and Russellville. The closest rail service to residents of Butler County is provided by the Illinois Central Railroad at Beaver Dam on the Green River or by the Louisville & Nashville Railroad in Hartford. Freight, siding, and switching services are provided at each location. Butler and Logan Counties are provided with commercial trucking services by companies such as Associated Transport, Inc., and McLean Trucking Company.

The nearest commercial air transport service is at the Bowling Green-Warren County Municipal Airport in Bowling Green. Fuqua Bus Line serves the communities of Morgantown and Adairville, and the Bowling Green-Hopkinsville Bus Line serves Russellville, Auburn, and Lewisburg.

Present and Projected Population¹

According to the 1970 census of population, Butler County had a population of 9,723 inhabitants, and Logan County had a population of 21,793. This represents an increase of 1.4 percent (137 persons) over the 1970 census count in Butler County, and an increase of 4.3 percent (897 persons) in Logan County during the same decennial period. During the same census decade, the Commonwealth of Kentucky registered an increase of 5.9 percent (181,555 persons). (Unless otherwise stated, all statistical data presented in the demography section are from U.S. Bureau of the Census, 1971.)

Table 8 shows the relative changes in population, both in absolute numbers and percentage of gain or loss, for Butler and Logan Counties during the 30-year period from 1940 to 1970. In addition, the tabulation provides a comparison of population trends in Butler and Logan Counties with those of adjacent counties, as well as with the entire state of Kentucky. The counties chosen for comparison are members of the Barren River Area Development District (BRADD), an organization whose goal is to provide assistance in the orderly socioeconomic growth

¹Dames & Moore conducted a survey of 20 percent of watershed residents in August 1974; data from this survey were used in the preparation of this section.

of communities and counties. Statewide population totals registered a constant increase in terms of absolute numbers for each decennial period between 1940 and 1970. However in Butler and Logan Counties, populations steadily declined from 1940 to 1960. As noted, during the 1960-1970 census period, they registered only a slight increase.

Butler and Logan Counties have a total of five incorporated cities, one of which--Russellville--is considered to be an urban place (an urban place is a settlement with 2,500 or more inhabitants: U.S. Bureau of the Census, 1972). Table 9 shows the population change in each of these incorporated cities between 1940 and 1970.

Age distribution within the populations of Butler and Logan Counties has not been proportionately the same during the last 30 years. While the absolute number of people in the younger (0-9, 10-19, and 20-29) and middle-aged 30-49 and 50-64) groups has decreased since 1940, the absolute number of people in the 65-and-over category has steadily increased during the same time span. The percentage of Butler and Logan County residents represented in the 65-and-over age group (14.2 and 13.2, respectively) is slightly higher than the statewide figure of 10.4 percent. Consequently, the median age of residents in these counties (31.9 years for Butler and 31.3 years for Logan County) is slightly higher than the statewide median age of 27.7. Table 10 shows the age distribution for residents of Butler and Logan Counties.

There has been a marked decrease in the number of live births among Butler and Logan County residents between 1960 and 1972. The number of live births fell from 175 to 133 in Butler County and from 455 to 376 in Logan County during that period of time (Barren River Area Development District, 1974). This is consistent with a trend established throughout the United States.

In terms of sex distribution, the 1970 Census indicated that the population of Butler County was almost equally divided among male and female inhabitants (Table 10). In Logan County, however, the census count showed more female inhabitants (51.3 percent) than males (48.7 percent). During the 1940, 1950, and 1960 census counts, there were more male than female inhabitants residing in Butler County. Similarly, the 1940 and 1950 decennial counts showed a greater number of males in Logan County, with the female population only slightly outnumbering the males in the 1960 count.

The 1970 Census indicated that the population of Butler and Logan Counties is predominantly white (99.2 and 89.9 percent, respectively, as compared to a 92.8 percent statewide dominance). The number of Blacks among the populations of both Butler and Logan Counties has steadily declined since 1950 (Table 11). Conversely, the number of Black residents in the state as a whole increased by 6.7 percent during the period from 1960 to 1970.

Persons of foreign stock constituted 0.9 percent of the population of Butler County in 1970, and the United Kingdom was the leading country of origin for the foreign-born population. Although persons of foreign stock represent a smaller percentage of the population of Logan County (0.2 percent), the United Kingdom was still the leading country of origin for the foreign-born population in that county.

A consistent decline in the total number of inhabitants in both Butler and Logan Counties between 1940 and 1960 resulted in a concomitant decrease in the number of people per square mile during that period of time (Table 12). In 1970, the population density of Butler and Logan Counties was 21.9 and 38.7 people per square mile, respectively. The statewide population density was comparatively higher (81.0 people per square mile) at that time.

The household density (or number of persons per household) of Butler and Logan County residences has declined since 1950 (Table 13). This is consistent with the statewide trend.

During the past several decades, there has been a national trend toward urbanization. This trend is quite apparent in the decennial data presented in Table 14. Although the population in Butler County is totally rural, the percentage of urban inhabitants in Logan County has steadily increased during the period from 1930 to 1970. There has been a constant migration of Logan County residents away from the farm. Concurrently there has been a steady increase in the rural nonfarm population in both counties.

Net migration (or difference between the natural increase and the net population change) is a good measure of the vitality of a particular region. Butler County registered a net increase of 0.5 percent (of county's 1960 population) during the decade from 1960 to 1970. During the same decade, Logan County experienced a 3.1 percent outmigration of county residents. Similarly, there was a marked 5.0 percent outmigration of inhabitants on the statewide level.

Of the counties directly adjacent to Butler and Logan, three experienced net outmigrations and three experienced net immigrations: Grayson (-3.3 percent), Muhlenberg (-5.9 percent), Todd (-11.4 percent), and Edmonson (+3.7 percent), Ohio (+4.2 percent), and Simpson (+5.4 percent). Warren County, also adjacent to Butler and Logan Counties, was not considered because it is 63.1 percent urbanized.

The Kentucky Program Development Office has generated a population projection for 10-year periods through the year 2020 (Table 15). These data project a gradual increase in the total number of future county residents during that period of time.

Economic Resources¹

In 1976, the size of the labor force in Butler and Logan Counties was reported to be 3,824 and 9,692 respectively. County employment figures for 1976 show that the largest single sector of the employed civilian work forces in both counties works in manufacturing occupations. Table 17 shows the distribution of the labor force in Butler and Logan Counties by industry.

Between 1965 and 1972, Butler County had a rather high rate of unemployment, averaging about 9.5 percent. During the same period, the unemployment rate in Logan County was substantially less, averaging around 3.3 percent. The statewide average during the same period was 4.8 percent as indicated in Table 18.

As shown in Table 19, 30.1 percent of the total work force in Butler County commuted to work in other counties during the census week in 1970. However, only 8.2 percent of the residents of Logan County had cause to work outside the county. The relatively few industrial establishments in Butler County (93) as compared to Logan County (364) would appear to account for the disparity.

In 1970, the Bureau of the Census calculated that, for the year 1969, the median family income of Butler County residents was \$4,772 as compared to \$6,252 in Logan County and \$7,439 on a statewide basis.

Table 20 provides a matrix for comparing the family income structure of Butler and Logan County residents with those in adjacent counties and Kentucky as a whole. As can be seen, the income characteristics for Butler County residents are inferior to adjacent counties and greatly inferior to average statewide characteristics. Logan County, on the other hand, compares quite favorably with adjacent counties and also with statewide characteristics. Warren County, which is to the east and directly adjacent to Butler and Logan Counties, leads all nine BRADD counties in every measure of family income presented in Table 20; however, this is expected by virtue of its position as the largest urban center (57,432 inhabitants) in the district.

In the watershed, the sale of farm products provides the residents with their principal source of income (Soil Conservation Service, 1974). Cash crop sales provided approximately 55 percent of the total farm income, and the marketing of livestock provided the other 45 percent. Corn, soybeans, hay, and some tobacco are the principal crops grown in the watershed. The market value of all Butler County agricultural products sold off farms with sales of \$2,500 or more amounted to \$5,836,000 in 1974. Logan County farms produced \$28,917,000 in 1974. Values of individual products are shown in Table 21.

¹Dames & Moore conducted a survey of 20 percent of watershed residents in August 1974; data from this survey were used in the preparation of this section.

In 1974, the Census of Agriculture recorded that there were 157,803 acres of farmland in Butler County, which represented approximately 56 percent of the county's 283,392 acres. In Logan County, the Census recorded 277,824 acres or 77 percent of the county, in farmland. Table 22 shows the distribution of total farm acreage within Butler and Logan Counties. There are about 325 farms (or portions thereof) in the watershed. These range in size from 3 to 700 acres; the approximate average is 150 acres.

In 1974, the Census of Agriculture showed that the average value of land and buildings was \$49,337 in Butler County and \$79,203 in Logan. Average value of land in that year was \$250 per acre for Butler County and \$455 for Logan. Land values in the watershed are comparable to the above, with bottomland values being about 50 to 75 percent higher than upland.

The number of farms and land in farms in both Butler and Logan Counties is declining (Table 23). Concurrent with the decline has been about a 15 percent increase in average farm size in the two counties.

The Big Muddy Creek Watershed is a rural, low-income agriculturally oriented area that partly depends on public assistance and wages earned in addition to farm income. Table 24 summarizes the family structure data obtained during the Dames & Moore field survey.

The average size of flood plain families is 3.2 persons. There were only 15 school-age children among the families interviewed, which yields a 1 to 2 ratio of school-age children to families (0.5 children per family). This ratio suggests that the parents either: (1) had not been married long enough to have school-age children or (2) were past the age bracket (25-44) characteristically considered to have school-age children in the family. Field observations tended to confirm the latter hypothesis.

Membership in social or civic organizations is a good measure of community involvement; 80 percent of the respondents did not belong to a social or civic organization. This statistic tends to indicate that the inhabitants of the flood plain are passive, sedentary people who are preoccupied with their own domestic activities.

The residents of the flood plain region maintain a fairly high degree of mobility. Sixty percent of those interviewed obtained their goods and services (banking, clothing, gasoline, groceries, etc.) in Morgantown; 20 percent traveled to Russellville, and 13.3 percent to Lewisburg for these goods and services; 6.6 percent used the local facilities at Quality for all but their gasoline and banking needs. In addition, 50 percent of those interviewed said they traveled to Bowling Green at least once each month because of larger selection of goods and services.

Other information that helps to identify the sociological character of the inhabitants of the watershed includes education level, poverty level, public assistance requirements, and available health facilities.

The years of school completed by residents of Butler and Logan Counties are shown in Table 25. As can be seen, Logan County residents possess a level of educational attainment that is generally similar to that of the Barren River Area Development District and the state of Kentucky; Butler County residents, however, are generally less educated.

Table 26 shows the percentage of the population in Butler and Logan Counties considered to be below the nationally established poverty threshold in 1969. The poverty threshold varies with the nature of the subgroup under consideration. For example, poverty thresholds range from \$1,487 for a female unrelated individual who is 65 years old or over and living on a farm to \$6,116 for a nonfarm family having a male head and seven or more members of the household.

Public assistance provides eligible individuals with financial aid for food, shelter, clothing, medical care, and other social services. The extent to which an area population depends on public assistance to maintain a certain level of subsistence is an excellent means of determining the vitality of the region. Table 27 shows the number of public assistance payments made to Butler and Logan County residents during Fiscal Year 1972-73. The incidence of public assistance is higher in Butler County (on a per capita basis) than in Logan County. Financial and medical aid to the aged, blind, disabled, and AFDC adults and children represents public assistance for 6.6 percent of Butler County's population. Another 1,837 Butler County residents (19 percent) receive Social Security benefits (U.S. Bureau of the Census, 1973); this means that over one-quarter of the population in Butler County is receiving financial or medical assistance (5.1 percent) and Social Security benefits (17.1 percent). The percentage of public assistance and Social Security recipients is slightly lower in BRADD as a whole, where 4.3 percent of the population received public assistance and 15.9 percent received Social Security benefits.

Table 28 is a compilation of the health care facilities and manpower in Butler and Logan Counties. Quite obviously, the extent of health care of Butler County is incommensurate with that of Logan County. The 66-bed Lakeview Health Care Facility in Morgantown is the only major health care facility in Butler County.

Plant and Animal Resources¹

Riparian vegetation of the Big Muddy Creek flood plain is a dominant oak-hickory forest interspersed with a bluestem-graminoid association (Küchler, 1964). Küchler (1964) describes the potential physiognomy of this forest type as a medium to tall broadleaf deciduous forest.

¹Dames & Moore conducted a survey of watershed vegetation and wildlife in August 1974; data from the survey was used in the preparation of this section.

A survey of five vegetative sampling areas within the Big Muddy Creek flood plain riparian forest are located as follows:

	<u>Latitude</u>	<u>Longitude</u>
Sampling Area 1	37°11'0"	86°46'33"
Sampling Area 2	37°9'12"	86°46'21"
Sampling Area 3	37°9'4"	86°46'36"
Sampling Area 4	37°2'47"	86°46'15"
Sampling Area 5	37°1'53"	86°49'6"

Because there is a marked diversity within the riparian vegetative type, the discussion of dominant species, overstory-understory relationships, and successional trends will be specific to each sampling area.

The most important species of Sampling Area 1 were pignut hickory (Carya ovalis), American sycamore (Platanus occidentalis), and shag-bark hickory (Carya ovata); these had respective overstory importance values of 68.7, 50.0, and 42.0 (Table 29). Signs of previous logging, relative high species diversity moderate basal area per acre, and stand heterogeneity indicate a submature climax association (Tables 29 and 30). A preponderance of boxelder as an understory tree species would suggest a successional trend toward a maple-hickory vegetative climax. Attenuating this directional succession, however, was the high percentage of diverse understory species complementing the characteristic overstory species. The close proximity of Sampling Area 1 to water has largely reduced the influence of fire on the successional pattern of the vegetation.

The most important species of Sampling Area 2 were pin oak (Quercus palustris) and red maple (Acer rubrum); these had overstory values of 147.1 and 47.6, respectively (Table 31). The important understory species were pin oak (Quercus palustris) and red maple (Acer rubrum), respectively (Table 32). The stand appeared to be immature. This was suggested by a relatively high overstory and understory average point distance to trees of 13.0 feet and 10.0 feet, respectively, combined with relatively few overstory trees per acre (175.3) and 105.18 square feet basal area per acre. The importance of pin oak and red maple in both overstory and understory vegetative covers having hydrophytic affinities suggested an oak-maple climax association. In addition, understory species such as buttonbush (Cephalanthus occidentalis) will not attain overstory status.

Sampling Area 3 was characterized by extreme species diversity, relatively low point-center to tree distance (8.7 and 5.5 for overstory and understory, respectively), and a relatively high overstory trees per acres (391.3), with a moderate basal area per acre of 117.4 square feet. This sampling area was immature, with evidences of past selective logging. Diversity of species composition (Tables 33 and 34) indicates the lack of a dominant climax association.

Sampling Area 4 (Tables 35 and 36) was the most mature riparian habitat surveyed. This was suggested by a relatively high point center to

tree distance (12.3 feet) and moderate tree density (195.8 trees/acre), while a basal area per acre of 192.8 square feet was maintained. The high understory density appeared to reflect the presence of shade-tolerant species rather than stand immaturity. Because of topographic relief, there was less riparian influence in the composition of the stand. Important mesophytic overstory species included Northern red oak (Quercus rubra), blue beech (Carpinus caroliniana), and sugar maple (Acer saccharum).

Sampling Area 5 was dominated by the overstory species american sycamore (Platanus occidentalis) and understory species spicebush (Lindera benzoin) and boxelder (Acer negundo) (Tables 37 and 38). The dominance of sycamore was largely due to extensive basal area and not relative frequency (Table 37). The low point-center distance to tree resulted in the highest number (400.2) of trees per acre within the sampled areas. This, in combination with the dense understory, suggested an immature stand. In the future the stand composition will be likely to remain the same, with dominant species including sycamore (Platanus occidentalis), sugarberry (Celtis laevigata), and boxelder (Acer negundo).

The more important overstory species in the Big Muddy Creek riparian vegetation type, based on frequency of occurrence in three or more sampling areas, were shagbark hickory (Carya ovata), pignut hickory (Carya ovalis), blue beech (Carpinus caroliniana), northern red oak (Quercus rubra), slipper elm (Ulmus rubra), sugarberry (Celtis laevigata), american sycamore (Platanus occidentalis), red maple (Acer rubrum), boxelder (Acer negundo), and white ash (Fraxinus americana). The most dominant understory species, based on frequency of occurrence in three or more sampling areas, were pignut hickory (Carya ovalis), blue beech (Carinus caroliniana), sugarberry (Celtis laevigata), red maple (Acer rubrum), boxelder (Acer negundo), and white ash (Fraxinus americana) (Table 39). The successional trends would indicate a decreasing importance of american sycamore (Platanus occidentalis) and northern red oak (Quercus rubra), with community stability indicated for the remaining species.

No species observed in the riparian vegetation type are considered rare or endangered (Wharton, 1974); however, regional disjuncts and phyto-geographic preferences often obscure the categorization of rare and endangered species. The sugarberry (Celtis laevigata) is an example of a species having regional distribution. This species is of common occurrence in western Kentucky though rather rare in central Kentucky. Several vegetative species also display edaphic preferences to geological formations (McInteer, 1947). Pin oak (Quercus palustris) is considered rare in the Eastern Coal Field but is abundant in the Western Coal Field.

Approximately 259 species of birds, 44 species of mammals, 32 species of reptiles, and 22 species of amphibians are present in the geographical area encompassing the Big Muddy Creek Watershed. Bird species occur primarily in the following manner (Barbour, et al., 1973; Robbins, et al., 1966; consult Table 40):

Permanent residents	- 24%
Regular or occasional summer visitors	- 30%
Regular or occasional winter visitors	- 20%
Spring or fall migrants	- 26%

The majority of mammal species are permanent watershed residents (Table 41), with the exception of members of the family Vespertilionidae (bats), which are regular or occasional visitors to the area. Reptiles and amphibians also are present in the watershed and were observed in the project area (Table 42).

Edge habitat--fencerows, hedgerows, woodland-field borders, and the tree borders of creek--appears abundant throughout the watershed. Edge habitat is important for the survival of many game and nongame wildlife such as bobwhite quail, cottontail rabbit, raccoon, a variety of songbirds, and to a lesser extent, white-tailed deer, mourning dove, and a variety of furbearing mammals.

In addition to edge habitat, the Big Muddy Creek Watershed also contains wetland habitat. Specifically, the watershed contains those types designed by Shaw and Fredine (1956) as Type 1--seasonally flooded basins or flats with a water depth of a few inches inland, a few feet along rivers--and Type 5-- inland open fresh water with a depth of up to 10 feet that may have a marshy border (Table 53). In the watershed, Type 1 occurs in the overflow bottomlands. These flood in late fall, winter or spring but usually are drained during much of the growing season. Deciduous forest, cropland, and pasture comprise the vegetation of the Type 1 wetlands (Table 43). Little or no wetland vegetation attractive to migrant ducks, such Scirpus or Carex, has become established along Big Muddy Creek; therefore the wood duck is the only commonly nesting migrant duck likely to inhabit the Big Muddy Creek Watershed.

Type 5 (Table 43) is represented by shallow farm ponds and reservoirs of present or future construction in the watershed. Open water such as farm ponds is commonly bordered by shrubs and emergent of submergent aquatic macrophytes; however, reservoirs have not yet developed a perimeter of aquatic plants.

Forty-six species of birds, nine species of mammals, and five species of amphibians or reptiles were noted during the survey of six sampling areas conducted by Dames & Moore. Three sampling areas were located in woodland and three were located in edge habitat. These sampling areas included a 10- to 20-foot-wide strip of trees bordering a field and a creek.

A total of 27 bird species was recorded in the six sampling areas (Table 44). In fields and pasture locations, barn swallows (Hirundo rustica) and eastern meadowlark (Sturnella magna) were the most numerous species. Other birds commonly associated with field habitat were the brown-headed cowbird (Molothrus ater) and the killdeer (Charadrius vociferus). Cowbirds were seen in large flocks (20 to 60 birds) in association with cattle herds.

The most numerous birds in the forest were the blue jay (Cyanocitta cristata), Carolina chickadee (Parus carolinensis), blue-gray gnatcatcher (Polioptila caerulea), and the cardinal (Cardinalis cardinalis). Most of the birds were observed in the canopy rather than in the sparse understory or on the ground. An average of 2.0 birds per 100 feet of transect were observed in the forest habitats, compared to 0.4 birds per 100 feet of transect in the fields.

Birds were less abundant in homogeneous communities of row crops than in heterogeneous forest community. The edge habitat investigated (Sampling Areas 3, 5, and 6) had fewer birds than field habitats. The relative abundance of birds in each community is likely to vary from season to season.

Fields and forests on upland sites were investigated indirectly; investigators recorded observations during travel on farm-to-market roads. Many of the same avian species recorded in comparable areas on the flood plain were observed in similar upland plant communities. Seventeen additional species were observed in the upland plant communities (Table 44), but they also reside in the bottomland habitats.

Avifauna follows noticeable successional trends in association with the succession patterns of plant communities, for example, the barn swallow, eastern meadowlark, and eastern kingbird (Tyrannus tyrannus) or Carolina wren (Thyrothorus ludovicianus), or indigo bunting (Passerina cyanea) in the edge habitats. Forest habitat will replace edge habitat in the successional trend and include the red-bellied woodpecker (Centurus carolinus) and red-eyed vireo (Vireo olivaceus). Many birds can be found in more than one plant community. Examples in the watershed include the yellow-billed cuckoo (Coccyzus americanus), blue jay, Carolina chickadee, common yellowthroat (Geothlypis trichas), and rufous-sided towhee (Pipilo erythrophthalmus).

Ten mammal species were noted in the Big Muddy Creek Watershed during the August survey (Table 41). All mammalian species noted are likely to occur in the upland as well as the bottomland habitats. Three cottontail rabbits were observed near roadside hedgerows in the uplands. No cottontail signs were observed in the lowland sampling areas, although the habitat appeared attractive near the hedgerows and forest edge.

Small mammal sampling was conducted on three sites; Sherman livetraps, with a mixture of peanut butter and oatmeal as bait, were employed. Traps were set for a total 140 trap nights and resulted in the capture of one white-footed deer mouse (Peromyscus leucopus). An excessive number of ants attracted to the bait was postulated as a probable cause of the low capture ratio.

Tracks of deer were frequently seen in the watershed, indicating that they are relatively abundant. Two white-tailed deer were observed in Sampling Area 2. Browse was abundant in all sampling areas, except

forest Sampling Areas 1 and 2, although greenbrier was extensively browsed in Sampling Areas 1. The forests generally have a closed canopy, which inhibits the growth of shrubs palatable to deer.

Hickory nut shells were found on the ground and on stumps where they had been left by chipmunks or squirrels. These signs were observed in Sampling Areas 1 and 4 and in upland forests near FRS 2, 4 and 7. Chipmunks and squirrels are common inhabitants of bottomland and upland forests. The tracks of raccoon were frequently observed along the banks of the Big Muddy Creek. Raccoon feeding habits were obvious in the freshwater mussel shells strewn along the creek, as well as damaged corn cobs. The edge habitat of the watershed serves as an important cover and concealment habitat for the raccoon, fox, and other furbearing mammals, though their main sources of forage are agriculturally developed lands.

Muskrat burrows were observed in the bank of FRS 2. Muskrat have probably increased in numbers in the watershed area since three completed floodwater retention ponds have increased their habitat.

Amphibians and reptiles were also a major animal group in the Big Muddy Creek Watershed (Table 42). Frogs were commonly seen in farm ponds, creeks and puddles formed in roadside ditches and ruts. The American Toad (*Bufo americana*) was noted on the woodland floor near FRS 2 and 3; while one was collected in Sampling Area 1. No salamanders were found; however, there is little doubt that they are present among the fauna of the watershed. Only two unidentified snakes and one fence lizard (*Sceloporus undulatus*) were recorded during the survey period. Aquatic turtles were frequently observed but not identified.

The important fauna of the Big Muddy Creek Watershed were identified as belonging to one of three classifications: (1) considered rare and endangered (consult Table 45); (2) economically important as game or furbearers; and (3) considered important as regulators in the ecosystem by their role as predators or prey.

Most of the rare or endangered birds are likely to be observed in western Kentucky as migrants only. Their dependence on the environment in the watershed for subsistence or survival is unlikely. No record exists of the red-cockaded woodpecker in Butler or Logan Counties. The most recent record was prior to 1960 in Fulton and Muhlenberg Counties, although there is some question about the validity of these records (Jackson, 1971). Bachman's warbler has not been recorded in western Kentucky in more than 20 years (USDI, 1973). The mature pine habitat required by the red-cockaded woodpecker and the swamp bottomland timber preferred by Bachman's warbler do not occur in the Big Muddy Creek Watershed.

The National Audubon Society has prepared a "Blue List" of animals that are declining in numbers (Barbour, *et al.*, 1973). Birds on the list that may occur in Butler or Logan Counties as seasonal visitors or permanent residents are as follows:

Double-crested cormorant
Black-crowned night heron
Turkey vulture
Black vulture
Sharp-shinned hawk
Cooper's hawk
Red-shouldered hawk
Loggerhead shrike

Marsh hawk
Osprey
Least tern
Barn swallow
Red-cockaded woodpecker
Bewick's wren
Eastern bluebird

The southeastern shrew and spotted skunk are near the northern edge of their range in the watershed area and are common in southern states. The southeastern bat, gray bat, and small-footed myotis may occur in Butler and Logan Counties. They are generally found in caves, rock crevasses, or tunnels. The southeastern bat is typically colonial in habits but is occasionally found in hollow trees or under bridges (Burt and Grossenheider, 1964). The small-footed myotis is occasionally found in or near forested areas and is probably the only rare or endangered myotis likely to be found in the Big Muddy Creek Watershed.

SCS consulted with U.S. Fish and Wildlife Service in compliance with Section 7 of the Endangered Species Act as revised in 1978. A biological assessment was conducted to determine if an endangered Indiana Bat (*myotis sodalis*) would be impacted by project installation. It was concluded that neither bat nor its critical habitat would be impacted. The U.S. Fish and Wildlife Service concurred in this conclusion.

Little is currently known about the distribution of rare or endangered amphibians and reptiles in western Kentucky. The western lesser siren favors cypress swamps and the sluggish waters of ditches and sluices probably as far east as Butler County (Barbour, 1971). Butler and Logan Counties may be on the western edge of the four-toed salamander's range. This species is an inhabitant of moist woodlands, where it breeds in shallow pools or streams and seeks shelter under rocks, logs, or moss. Although the distribution of the eastern ribbon snake is statewide, few records of sightings exist within the state. The prairie king snake prefers old fields and grassland within its range, which includes Butler and Logan Counties.

The important game birds of the area include waterfowl, bobwhite, mourning dove, and woodcock. Waterfowl are common transients through western Kentucky. Those species most likely to alight on farm ponds and impoundments in the Big Muddy Creek Watershed are the mallard (*Anas platyrhynchos*), black duck (*Anas rubripes*), pintail (*Anas acuta*), greenwinged teal (*Anas americana*), northern shoveler (*Anas clypeata*), wood duck (*Aix sponsa*), ring-necked duck (*Aythya collaris*), canvasback (*Aythya valisineria*), lesser scaup (*Aythya affinis*), common goldeneye (*Bucephala clangula*), bufflehead (*Bucephala albeola*), hooded merganser (*Lophodytes cucullatus*), common merganser (*Mergus merganser*), and red-breasted merganser (*Mergus serrator*) (Barbour, et al. 1973).

The mallard, black duck, blue-winged teal, wood duck, ring-necked duck, lesser scaup, bufflehead, hooded merganser, and common

merganser are common winter residents in western Kentucky. They are likely to occur in small numbers on ponds, impoundments, or waterways such as those in the Big Muddy Creek Watershed.

Bobwhite quail is a significant small game resource in Butler and Logan Counties. The Kentucky Department of Fish and Wildlife Resources conducted a mail survey of hunters during the 1961 to 1962, 1962 to 1963, and 1963 to 1964 hunting sessions (Table 46). The number of hunters contacted represented between 1.0 and 1.9 percent of the total license sales in each county. Although the data in Table 46 present information gathered 10 years ago, they are believed representative of the productivity of the counties and, in particular, the Big Muddy Creek Watershed. A decline in licenses sold in Butler and an increase in sales occurring in Logan County should be noted in comparison to the 1961 through 1963 hunting seasons. Bobwhite provide between 30 to 34 percent of the estimated total small game harvested in Butler and Logan Counties. The productivity of the two-county region is moderate to high, assuming the number of avifauna harvested is between 30 and 40 percent of the entire bobwhite population. This estimate represents an important recreational resource for the two-county area.

The edge habitat and grasslands provide abundant nesting and summer cover for bobwhite. Winter cover includes low-hanging boughs, herbaceous vegetation, and thickets of *Rubus* sp., honeysuckle and other herbaceous plants (Yoho and Dimmick, 1972). Edge habitat is important to bobwhite quail for survival during the winter and for cover during the spring breeding season. Baxter and Wolfe (1972) reported that the number of bobwhite responding to calls on a management area in Nebraska in the spring was directly related to the abundance of edge habitat.

The mourning dove is an abundant game bird in Butler and Logan Counties. They comprise between 6 and 18 percent of the small game harvest presented in Table 46. These figures are not representative of the productivity of the habitat because of the migratory habits of mourning doves. It is thought that there is an abundance of this species in the watershed area. The distribution of cultivated land devoted to corn and other small seed-producing crops, as well as the distribution of woodland edge and hedgerows, provides good to excellent mourning dove habitat. Nest sites are commonly selected in trees or shrubs along the edge of clearings, such as cultivated land, fields, or pasture (Moore and Pearson, 1941; Uhlig and Hamor, 1960). Corn, sorghum and soybeans, which are cultivated in the Big Muddy Creek Watershed, are important in the mourning dove diet (Moore and Pearson, 1941).

The American woodcock is a game bird of minor importance in western Kentucky. It is an uncommon migrant and rare nester in the state (Monroe, 1969). One out of 20 hunters responding to a mail survey in Butler County reported killing three or more woodcock during the 1962 to 1963 season. A single woodcock was flushed from Sampling Area 1 in August 1974.

The wild turkey is not currently a game bird in Butler County; however, according to Mr. E. K. Nelson of the Kentucky Department of Fish and Wildlife Resources, birds were released in 1972 in the vicinity of State Highway 70 at the Green River crossing. The mixed hardwood forests and fields in the Big Muddy Creek Watershed would provide suitable habitat for turkeys should they move into the watershed.

Cottontail rabbit and gray and fox squirrel are important game mammals. The raccoon, opossum, mink, skunk, red and gray fox, and groundhog are common furbearers found in the Big Muddy Creek Watershed. The white-tailed deer also is an important game animal in Kentucky, and deer are becoming common in the watershed. According to Robert L. Willis (1974), District Wildlife Biologist, Kentucky Department of Fish and Wildlife Resources, introductions of deer were made in the late '50's and are the reason for the commonness of deer in the watershed area. Tracks were encountered in upland and bottomland habitats in the August 1974 survey, indicating that they are very common. According to a general review of deer habitat of the southeast by Stransky (1969), bottomland forests are preferred by deer because bottomland soils produce more food than upland soils. Browse is not abundant in flood plain forests of the Big Muddy Creek Watershed; however, it is plentiful along hedgerows, in the narrow belt of trees growing along the creek, and in other edge habitat. Sorghum and other cultivated crops supplement the summer diet of deer. The bottomland and upland forests provide important cover for deer throughout the year.

Squirrels comprise between 22 and 31 percent of the estimated small game harvest in Butler and Logan Counties (Table 46). Because the squirrel hunting season in Kentucky is longer than the hunting season for other small game species, the total number of squirrels taken is larger than for other mammals. Nevertheless, the data (Table 46) show squirrels to be abundant throughout the forests of both counties. The numerous oak, hickory, maple, sweet gum, and other hardwood trees provide an abundant food supply of fruits and seeds throughout the year. The natural food supply is supplemented by cultivated crops in the fall.

The cottontail rabbit is apparently a major game animal, judged by the mail survey results (Table 46). Cottontail comprised between 18 and 22 percent of the total estimated small game harvest in Butler and Logan Counties. The abundance of cover from edge habitat throughout the watershed is an important factor contributing to an abundance of cottontail rabbits. Forest edge, hedgerow, fencerow, and roadside borders are more common in the uplands than in the bottomlands, where agriculture is more intensive.

The final important wildlife category is the predators that help regulate invertebrates, fish, and other wildlife numbers. The predator species of wildlife are noted in Tables 40, 41, 42, and 46.

Raptors are common in the Big Muddy Creek areas and help control the natural rate of increase in numbers of various prey populations such as the prairie vole (Microtus ochrogaster), white-footed mouse

(Peromyscus leucopus), the eastern chipmunk (Tamias striatus), and other small mammals that occur in the watershed (Table 41). The red and gray fox are the most important predatory mammals common to the watershed. These two species feed on mammals as large as the cotton-tail rabbit and as small as the white-footed mouse.

The principal aquatic habitats in the Big Muddy Creek Watershed are Big Muddy Creek and its major tributaries, the four flood retarding structures, and farm ponds (see section on Hydrology and Flooding for a description of the Big Muddy Creek drainage system).¹

The four flood retarding structures range in size from 16 to 105 acres and provide a combined surface area of 224 acres at normal (sediment) pool elevation. There are currently 189 ponds in the watershed approximately 100 of which have been constructed since initiation of the original work plan in 1962. The farm ponds range in size from 0.3 acres to over 5 acres, with a combined surface area of approximately 70 acres. In addition to the farm ponds, there are four coal strip mine pits of approximately 5 to 6 acres each; however, these are probably too acidic for fish survival.

Unlike wildlife species, which may be closely identified with regional climatic and vegetational characteristics, the areal distribution of fishes is characterized primarily by drainage systems and secondarily by topography. Two drainage systems may, therefore, be in the same region and adjacent to each other but differ greatly in their indigenous fish species. However, since the Green River is a proximate stream in the drainage system to which Big Muddy Creek belongs, the fish fauna can be expected to represent at least a portion of the Green River species composition. The portion represented will be largely determined by the availability of suitable habitat and food web organisms in Big Muddy Creek and its principal tributaries. Also, the Green River may serve as a fish reservoir from which certain species may move into Big Muddy Creek to spawn and during periods of flooding to feed.

Eighteen families, 42 genera, and 107 species of fish were identified from population studies conducted on the Green River from 1960 to 1963 by the Kentucky Department of Fish and Wildlife Resources (Charles, 1964). Fishes known to occur in Kentucky include 26 families, 67 genera, and 177 species. Thirteen families, 23 genera, and 31 species were collected in the Big Muddy Creek drainage during the fish resources survey conducted in August 1974 (Table 47). Although not represented in the collection, additional species are known to occur, at least seasonally (Gresh, 1962).

Dr. Morgan Sisk of Murray State University (1974) reported collecting the following species from Big Muddy Creek at its confluence with the Green River during the period 1962-1963:

¹Dames & Moore conducted a fish resources survey of the watershed in August 1974; data from the survey were used in the preparation of the following discussion.

Dusky darter
Logperch
Longhead darter
Eastern sand darter
Greenside darter

Percina sciera
Percina caprodes
Percina macrocephala
Ammocrypta pellucida
Etheostoma blennioides

Species occurring in the Green River drainage (Charles, 1964) that are potential inhabitants of the Big Muddy Creek drainage, especially during flood periods or the spawning season, include a number of catostomids (suckers), white bass (Roccus chrysops), and smallmouth bass (Micropterus dolomieu).

Little if any biological research has been done on the Big Muddy Creek drainage. The Bureau of Sport Fisheries and Wildlife and the Kentucky Department of Fish and Wildlife Resources cooperated in a reconnaissance survey of the fish and wildlife resources of the Big Muddy Creek Watershed in 1962, as required by the Watershed Protection and Flood Prevention Act (Gresh, 1962). Charles (1964) conducted extensive studies of the effect of brines from the Greensburg oil field on fish, benthic organisms, and water quality in the Green River from 1960 through 1963. Williams (1969) investigated the mussel fishery in the Green River from 1966 through 1969.

Fish sampling was conducted at four locations (Appendix D, Figure 3) representing the major stream habitats. Quantitative and limited qualitative fish sampling was used to determine indigenous species and to document the presence of any threatened or endangered fish.

Eight species of sport fishes, two species of rough fishes, and 21 species of forage and other fishes were collected during the field program. The species composition and relative abundance of fish in representative portions of the Big Muddy Creek drainage were considered to provide an adequate index of the existing quality of the aquatic environment in the proposed project area.

Aquatic macrophytes were observed only in the area between points P and K (Appendix D, Figure 3) where relatively extensive beds of the water willow (Diathera americana), an emergent, occurred.

Station 1-A, the first of three stations of Big Muddy Creek, was located near the downstream end of the project area and approximately 2½ miles from the confluence of Big Muddy Creek and the Green River. According to Horton (1945) system of stream classification, Big Muddy Creek is an Order IV stream at this station. The channel was altered in the station area in 1929. The average depth of the stream at this point was about 3 feet (4½ feet maximum) and the average width about 20 feet. The banks were steep, and the stream bottom consisted of mud and detritus with deposits as deep as 3 feet in places. The stream was heavily shaded at this point.

Station 2-A (Order IV stream) was located in the central portion of Big Muddy Creek and about 3½ miles downstream from the upper end of the 1929 channel alteration. The average depth of the water was about 3

feet, which was also the maximum depth, and the average width was about 20 feet. The creek at this point has steep banks, is heavily shaded, and has a hard mud and clay bottom.

Station 3-A (Order III stream) was located in the upper portion of Big Muddy Creek about $1\frac{1}{2}$ miles above the upper end of the 1919 channel alteration and about $1\frac{3}{10}$ miles below FRS 1. The average depth of the water was about $2\frac{1}{2}$ feet ($3\frac{1}{2}$ feet maximum depth), and the average width was about 10 feet. The creek at this point has steep sides, is moderately shaded, and has a bottom of mud and detritus.

Station 4-A (Order II stream) is on Duncan Creek, which, with Dallum Creek, forms the right fork of Big Muddy Creek. This fork is upstream from areas where the channel was previously altered and about 500 yards downstream from the proposed FRS 7. Both shallow riffles and pools were present at this station; the stream had an average depth of about 2 feet (maximum depth about $2\frac{1}{2}$ feet) and a width of about 10 feet. The banks were steep, the creek moderately shaded, and the bottom a rubble-gravel complex.

A total of 31 species of fishes was recorded for the four sampling areas (Table 47). The relative abundance of fish by family is expressed as a percentage of the total biomass collected at each station (Table 48). Also, the total biomass collected at Stations 1-A, 2-A, and 3-A is expressed as weight per-unit-area (lb/acre), an indication of the standing crop. The sample collected at Station 4 was qualitative and therefore did not provide a weight per-unit-area.

Station 3-A, in the unaltered upper portion of the Big Muddy Creek, had the most diverse fish community. Station 4-A, in the nonchanneled portion of Duncan Creek, had the lowest diversity of species. Five species (Stoneroller, bluntnose minnow, creek chub, creek chubsucker, and banded sculpin) collected at this station were not collected at any of the other stations. This was presumably because of the different habitat type provided by riffle areas and graveled bottoms. The centrarchidae (sunfish) was the most abundant group at Stations 1-A, 2-A, and 3-A; the cyprinidae (minnows) was the most abundant group at Station 4-A.

The fish biomass (apparent standing crop) at Station 3-A (unaltered area) was approximately 2.6 times greater (lb/acre basis) than the average biomass for stations 1-A and 2-A in the altered area. Studies by Bayless and Smith (1967) and reports by Wharton (1970) have shown drastic reductions in standing crops of fishes after channel alteration. Studies by Congdam (1971) and others indicate only a partial recovery of the fish population in some streams undergoing channel alteration after a period of 15 to 30 years.

Gresh (1962), in his report of the reconnaissance survey of the Big Muddy Creek Watershed, noted that the fishery of the main stem of Big Muddy Creek was moderately high and supported "rather heavy" seasonal angling for largemouth bass, bluegill, and catfishes, and that fishing success was good. "Suckers are utilized heavily in the upper reaches during the spring spawning run."

Fishing license sales have increased by nearly 1000 during the past 5 years in Butler and Logan Counties (Kentucky Department of Fish and Wildlife Resources, 1974). With increasing numbers of fishermen, the available fisheries resources can be expected to receive additional fishing pressure in the future.

Concurrent with fisheries sampling, random collection of the larger benthic macroinvertebrates was made at each of the four fish sampling stations. The following benthos were collected: crayfish (Orconectes sp.) at Station 1-A, 2-A, 3-A and 4-A; crayfish (Procamberus sp.) at Station 2A; freshwater shrimp (Palamonetes sp.), bivalves (Unio sp., exoskeleton) at Stations 1-A and 3-A; dragonfly nymph (Didymops sp.) at Station 2-A; snails (Campeloma sp. and Pomatiopsis sp., exoskeleton) at Station 3-A.

Thirty-one species of endangered fishes in the United States are listed in the United States List of Endangered Fauna (May 1974); however, based on the distribution given in Threatened Wildlife of the United States (USDI, 1973), none of these species are likely to occur in Kentucky.

Miller (1972) lists 18 species occurring in Kentucky as rare, endangered, or depleted; the longhead darter is listed as endangered.

Recreational Resources

Table 49 is an inventory of the existing recreation facilities in Butler and Logan Counties. The Commonwealth of Kentucky has issued a State Comprehensive Outdoor Recreation Plan (SCORP), which identifies the existing supply and projected demand for recreation facilities throughout the state on an Area Development District (ADD) basis (Kentucky Department of Parks, 1973). After considering projected population trends and the supply of existing recreational facilities in the ten-county Barren River Area Development (BRADD)--which includes Butler and Logan Counties--SCORP estimated that the district was in need of the following facilities:

1. 772 acres for five 18-hole golf courses
2. Two swimming pools
3. 1300 acres of additional hunting area
4. 18 miles of bicycling trails
5. 51 acres of outdoor game facilities

SCORP projected that waterbased recreational facilities would prove to be adequate for prime season and length-of-season needs until 1990; but they are considered inadequate for peaking needs. See Table 50 for a more definitive breakdown of BRADD recreational needs.

According to BRADD (1974), "there is a definite lack of recreation opportunity in Butler County." From an economic standpoint, it does not appear feasible to develop major recreational facilities at Morgantown

(the largest community in the county) because of the relatively low population. Because there is neither an active planning commission nor a parks and recreation board in Butler County, BRADD recommended that Butler County and the community of Morgantown conjointly create a City-County Parks and Recreation Board to supervise recreation development throughout the county.

Logan County, on the other hand, possesses an active joint City-County Planning Commission that has served to guide the development of recreational facilities in that county. Municipal recreation boards exist in Auburn and Russellville.

Since all of the acreage within the watershed is privately owned (with the exception of highway rights-of-way and public school property), the recreational opportunities in that area are restricted to fishing and hunting.

Information provided by the Kentucky Department of Fish and Wildlife Resources (personal communication, 1974) shows an increase in combination hunting and fishing license sales in Butler and Logan Counties during the last 5 years (1969 to 1973) from 4724 to 5469. Over \$33,400 was collected for combination hunting and fishing resident and nonresident fishing licenses in the two counties in 1973.

Archeological and Historical Values and Unique Scenic Resources

Aesthetic quality of a particular area is a subjective matter determined by individual perceptions and values. In general, however, the aesthetic quality of the watershed is quite similar to that of the adjacent landscape. Although the rural, agricultural milieu may be characterized as aesthetically appealing, there are no unusual natural or historic features that would be considered unique to the region.

There are no historic sites listed for the watershed in the National Register of Historic Places (1979). However, the Kentucky Heritage Commission (Spindletop Research, Inc., 1971) has designated the Bethel Baptist Church, located off State Route 70 in South Hill, as a historic site. The site is near the watershed divide line and will not be impacted by the planned project.

In September and October 1974, an onsite archeological reconnaissance was made by the Museum of Anthropology, University of Kentucky, of the proposed reservoir and 17.5 miles of stream channel modification. Three archeological sites and seven archeological localities were found.

The distinction between a locality and a site is an important one in terms of survey strategy; the difference between the two is primarily quantitative. The presence of relatively little surface material (generally consisting of chert flakes) would be defined as a locality, whereas the presence of a large quantity and variety of material would be a site. In general, test excavations are warranted in sites but not localities.

Two of the three sites were not investigated either because they were out of the impact areas or because soil erosion had occurred to the point that further archeological investigation was unwarranted. The remaining site was tested to evaluate its importance. The materials recovered at this site were not diagnostic.¹ In the event that construction endangers site LO-15 as described in the archeological survey, test excavations will be made.

Land, Water, and Plant Management Status

There has not been a substantial change in the overall pattern of land use in the Big Muddy Creek Watershed since 1958. Cropland acreage has increased by about 5 percent, pastureland has increased by about 1 percent, woodland has increased by about 5 percent, and other land has decreased by approximately 30 percent. This decrease in the "other land" category has been due to a change in the interpretation of the definition of "other land." For example, some of the acreage classified as other land in 1958 was brushland, which has since been cleared for use as pasture or cropland or has been reclassified as woodland.

Upland land use is generally fair, according to its capability. Cleared land furnishes fair to poor cover conditions for reductions of runoff and soil erosion. Much of the watershed is in need of basic farm planning and application of conservation measures. The following types of land are presently among the acreage used for crop production: marginal land (1800 acres); flood plain area subject to frequent flooding (3750 acres); and areas needing drainage (4500 acres).

The Conservation Districts are involved in carrying out their responsibilities under the watershed land treatment program by assisting landowners in planning and applying conservation practices and by conducting a regular promotion and publicity program. Currently, there are 226 farms under cooperative agreement with the Sponsoring Local Conservation Districts, 159 of which had adopted soil and water conservation plans for their land. Approximately 57 percent of the watershed area is owned by property owners that participate in conservation planning programs.

It is estimated that, to date, approximately 80 percent of the land treatment practices delineated in the work plan has been applied. Further, it is estimated that planned land treatment practices have been implemented on 72 percent of the cropland, on 85 percent of the pastureland, on 90 percent of the woodland, and on 100 percent of the wildlife habitat specified in the work plan.

Conservation practices planned for the watershed under the land treatment program are quite varied but consist mainly of pasture planting, conservation cropping systems, waterways, and diversions. The actual

¹Betty McGraw's "An Archeological Survey and Appraisal of the Big Muddy Watershed Project" submitted to the United States Department of Agriculture, Soil Conservation Service by the University of Kentucky Museum of Anthropology in accordance with the provisions of Contract No. AG21SCS-00224.

percentage of the planned practices completed to date varies from 15 percent for diversions to 80 or 90 percent for pasture planting and critical area and minimum tillage. Generally a higher percentage of the agronomy than mechanical practices have been completed to date. It is estimated that 17,700 acres of woodland, 10,000 acres of pastureland, 6,500 acres of cropland, and 1,300 acres of other land are adequately treated.

There are at least two factors which serve to influence the adequacy of soil, water, and plant management in the watershed. One factor is the trend for increased prices for grain and the relatively low price of cattle. It is anticipated that a more intensive use of the land for crop production will occur if this trend continues. The other factor is the increasing number of part-time farmers who are turning to crop production because of grain price increases and lower investment costs. This factor, too, will cause a more intensive use of the land and will also tend to create some soil erosion problems.

Projects of Other Agencies

The U.S. Army Corps of Engineers maintains a Green and Barren Rivers lock and dam (L&D) system for navigational purposes. The lower 103 miles of Green River were improved in 1955 for a 9-foot clear navigation channel. L&D 3 in the Green River (at river miles 108.5) is located approximately 10 miles below the Green's confluence with Big Muddy Creek and approximately 5.5 miles upstream from the upstream limit of channel maintenance. Lock and Dam 3, while manned by the Corps, is used almost exclusively by pleasure craft. The channel upstream is not maintained.

The Corps of Engineers is presently conducting survey studies of the Green and Barren River Navigation Project.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land and Water Management

The upland use is generally fair according to its capability. The cleared land furnishes fair to poor cover conditions for reduction of runoff and soil erosion. A large acreage needs basic farm planning and application of conservation measures.

Forest stands are entirely of the hardwood type. Past use of the forest land is responsible for the present stand size conditions. A large percentage of the stands is immature but has a high economic and hydrologic potential for the future. Given protection, care, and management, the forest stands may be expected to contribute substantially to the future overall economy of the watershed.

There is no expressed need for the impoundment of water for agricultural use other than individual farm ponds; there are likewise no urban requirements for water storage in the foreseeable future.

Dissolved oxygen levels below state standards were recorded in the lower section of Big Muddy Creek during the August 1974 Dames & Moore survey. The low DO in this section was attributed to sawdust from a sawmill near State Highway 70 bridge. Higher-than-normal values obtained for sulfates in this section were probably due to acid drainage from coal strip mines. Such drainage could constitute a minor problem. Some additional sources of pollution are present in the watershed but are not considered a problem at present.

Floodwater Damages

Floodwater damage is the major watershed problem. The annual rainfall pattern and present upland hydrologic cover conditions give rise to excessive runoff from high frequency storms. The present stream channel capacity cannot carry excess runoff from high intensity or long duration storms. The storm condition results in floodwater damages to crops and pasture and other agricultural improvement in the flood plain. Principal floodwater damage occurs to crops, pasture, and fences. Additionally, time, effort, and expense are involved in the removal of floodwater-deposited debris.

The major flood (50-year frequency) occurring in the frequency series would inundate approximately 5538 acres on Big Muddy Creek and down-stream on the main tributaries on which structural measures are planned. Further analysis of the frequency study revealed 5156 acres would be inundated by a 10-year flood, 4802 acres by a 5-year flood, and 3292 by a 2-year flood. The flood plain farmers expect some flood damage from one to three floods every growing season. The most damaging aspects of the recurring floods are delayed plantings and replanting. Physical improvements, with the exception of roads, are at a minimum in the flood plain area because of the flood hazard.

Not only are the spring and summer floods directly damaging to crops and pasture, but the frequency of floods prevents farmers from operating their lands at the limit of intensity conducive to the most practical net returns. The total evaluated flood plain comprises some 8.5 percent of the watershed area. This flood plain acreage represents a major portion of the operation on about 150 farms. Most farms do not have suitable acreage to permit any offsetting outlets for production resources when flooding destroys crops. As a result, the overall economy of the watershed is adversely affected by the floodwater problems.

The average annual floodwater damage to crops and pasture is estimated to be \$72,800; to other agricultural endeavors, \$5000; and to roads and bridges, \$2700. Thus, the total annual floodwater damage is about \$80,500.

Sediment and Erosion Damages

Sediment damage is limited to the loss of effectiveness of the down-stream watershed channel and sediment deposition in the Green River navigation channel below the confluence with Big Muddy Creek.

Damage from sedimentation has gradually decreased the capacity of Big Muddy Creek since about 1941, when adequate maintenance on the channel was discontinued.

Sedimentation damages to the agricultural flood plain and transportation facilities were examined, but did not warrant a detailed investigation. The minor damages which do occur are incorporated with floodwater damages for economic analysis.

The primary erosion damage is sheet erosion, which is also the major source of sediment. There are no major individual or group gully developments in the watershed. The overall effect of erosion on agricultural production was not evaluated; therefore no monetary value was placed on erosion damage. However, some present upland land use is limited because of erodibility of some soil types.

Economic and Social Problems

As previously described, the existing socioeconomic environment of the Big Muddy Creek Watershed is that of a low-income, agriculturally oriented area, where a substantial percentage of the inhabitants are receiving public assistance or are compelled to find supplemental or alternative sources of income to meet their basic needs. Approximately 42 percent of the farm operators reported farm incomes of less than \$2500 per year (U.S. Bureau of the Census, 1971). This situation is not uncommon to regions where the local economy is largely based on agricultural activities.

Certain demographic factors, such as a pattern of rural outmigration over the past few decades and a stable increase in the median age and number of people over 65 years old, have aided in creating the present socioeconomic situation. An examination of particular economic indicators, such as the rate of employment/unemployment, wholesale and retail trade, and personal income, revealed that there is an obvious need for new jobs to stimulate the economy of the watershed area, which lies predominantly within Butler County.

The availability of an abundant supply of labor has served to stimulate industrial development in the southern states in the past 20 years. Although Butler and Logan Counties have experienced a certain amount of industrial growth during the last two decades, the industrialization of Logan County has far surpassed that of Butler County. It has been recommended that the surplus of labor in Butler County supplement the depleting work force of Logan County (Ware, Lewis, and Eaton, 1970), but a preferable alternative from the standpoint of economic development in Butler County would be achieved through increased industrialization of Butler County. In this manner, the unemployment rate would be reduced, and the county would receive solid economic undergirding.

Other socioeconomic problems include inadequate health care facilities and a paucity of rural community development promotion in the watershed.

Plant and Animal Problems

The riparian vegetative type along the Big Muddy Creek has been subjected to logging, past and present. Management decisions and level of protection employed will ultimately determine the fate of this vegetative type.

Current periodic inundation has little detrimental effect on species vitality. Most species of this vegetation type have become adapted to a wetland habitat. Little organic matter has been deposited due to periodic scouring. Soil deposition has been minimal largely in response to low load capacity of Big Muddy Creek.

Some wildlife habitat is being lost to current logging operations. Flooding by Big Muddy Creek may result in the loss of the young of some wildlife species during spring or summer floods.

Recreation Problems

Public outdoor recreation within the watershed primarily consists of hunting and fishing. Residents of the watershed are compelled to travel outside the watershed for other activities. The Barren River Area Development District (1974) has stated that there is a definite lack of recreational opportunity in Butler County and has recommended that a 20- to 100-acre community park be developed in or near Morgantown. In addition, BRADD has specified that Butler County is in need of a parks and recreation board to supervise recreation development throughout the county. In Logan County, the Joint City-County Planning Commission has developed a land use plan which recommends the development of various recreational facilities in that county also. Generally, the 10-county area possesses a variety of recreational facilities, but BRADD has recommended the development of several additional facilities to meet the projected future demands.

Relationship of Land Use Plans, Policies, and Controls

Butler and Logan Counties are part of BRADD, one of the 15 regional development organizations in the state of Kentucky. The goals of BRADD are: (1) to fully develop the potential of the area's resources in commerce, industry, agriculture, tourism, recreation, forestry, and wildlife; (2) to maximize the potential for socioeconomic development; and (3) to ensure development opportunities through flood control, sewage and solid waste disposal, water and air pollution abatement, and development of adequate water supplies.

According to Mr. Don Eggert (1974), Chief Planner with BRADD, the project is consistent with district-wide projects, goals, and plans.

ENVIRONMENTAL IMPACT

Conservation Land Treatment

Installation of land treatment measures will reduce annual gross erosion rates by about 20 percent. Sediment damages will be reduced by nearly \$1000, or about 7.5 percent as a result of installation of land treatment measures. Reduced erosion rates will improve the agricultural and forestry potential of the watershed. Reduced sediment yield will help reduce channel filling within the watershed.

Land treatment measures will combine with the structural measures to protect the productive agricultural base on the watershed by substantially reducing annual floodwater damages to crops and pasture, other agricultural areas, and roads and bridges, as well as the annual sediment damages within the watershed.

Land treatment measures will help maintain or increase present wildlife populations.

Structural Measures

After the channel alterations are made and FRS 7 is constructed, 1497 acres will be disburdened from the threat of floodwater damage from 50-year frequency storms. Furthermore, 5-year frequency storms will be confined within the stream banks. This means that practically all of the 4802 acres flooded by 5-year storms will be floodfree during the cropping season.

The majority of the sections of the Big Muddy that are designated for channel modification were previously altered in 1920. This prior modification resulted in a reduced fisheries potential, compared to natural sections of the Big Muddy. Thus, precautions taken during remodification, such as immediate seeding of disturbed areas, sediment basins, and reconstructed riffle areas, where possible, and controlled burnings should result in gradual reestablishment of the minimal fisheries now present in the modified sections.

During the period of denudation, before precautionary measures become effective, an increase in water temperature and sediment load (turbidity) will occur. However, these increases will have minimal effect because fishes will either have emigrated or been destroyed directly by dredging.

Water temperature increases and associated lower DO values are probably the only water quality parameters that will continue to be affected after return of fish populations. Because increased water temperatures are the result of destruction of the riparian vegetation (mature trees), the effects will be reduced by removing vegetation from only one side of the creek.

Construction of FRS 7 would eliminate most of the riparian (streamside) vegetation found within the area of proposed inundation.

Generally, reproduction and growth of lowland hardwoods occur during relatively dry periods. Hosner and Minckler (1963) consider moisture and soil conditions to largely share the scope and direction of lowland hardwood growth. It is expected that channel modification would also increase the probability of limiting the growth of native riparian (streamside) vegetation. This vegetation would subsequently be replanted with woody and herbaceous species during the revegetation phase of the channel structural program.

Reduction of terrestrial habitat will take two forms: alteration of habitat during channel modification and elimination of habitat subsequent to modification. Alteration of habitat will occur in the watershed where land is cleared, roads are constructed, or channel spoil piles are created. Each of these alterations of habitat will eliminate any previously established habitat.

Land clearing and diversion resulting from channel modification will have a pronounced effect on the terrestrial wildlife within the area. The effect of channel modification in the area required for construction will be to change currently available habitat from forage production and cover to idle land of low productivity while the channel is being modified. This land use alteration will result in less suitable wildlife habitat. Temporary habitat reduction will cause mobile wildlife to leave the area; the more sedentary species probably will be eliminated by severe restrictions of their specific habitat requirements. Implementation of the channel improvement program will transform additional wildlife habitat into intensive agricultural purposes within the watershed, thus further limiting natural wildlife habitat and its associated forage cover and nesting sites. Some wildlife may be eliminated through intensified competition for food and territory. To a limited extent, some wildlife species, i.e., raccoon, opossum, mourning dove, and bobwhite, may be able to use the areas converted to agriculture to their advantage during periods of crop production.

The scope of the Big Muddy Creek project was such that it was economically infeasible to determine the absolute numbers of mobile wildlife that would emigrate or of sedentary wildlife that would perish as a result of channel modification. However, qualitative estimates are available and are presented herewith.

White-tailed deer will be relatively unaffected by channel modification. Although there will be several individuals displaced, this will be of a temporary nature and is not expected to significantly impact the population.

There will be a net loss in the squirrel population due to the destruction of preferred streamside habitat rather than from emigration. This loss, however, is expected to be quite small due to the very limited extent of streamside vegetation that now exists.

Cottontails, opossums, and most furbearing mammals will be affected little. Although emigration from disturbed areas is expected, the populations of these species in the general area are sufficiently low to

allow for increased habitat utilization by emigrating animals. The muskrats in Big Muddy Creek will be affected directly by the project--almost all of their habitat will be destroyed. It is expected that little migration will occur--the population of these mammals will simply be lost as a consequence of the project. This loss will not be great, however, since muskrats are not abundant in Big Muddy Creek--partially as a result of the previous channelization. The raccoon population will also suffer due to the removal of suitable habitat for mussels and crayfish, two of the staples in the raccoon's diet. It is expected that most raccoons in the project area will emigrate to surrounding areas where there are sufficient resources to support them. The losses that do occur in the project area are expected to be slight.

The impoundment created by FRS 7 (in addition to numerous farm ponds constructed under the land treatment program) will provide new habitat for aquatic biota and waterfowl.

The only fish migration pattern presumed to be affected by structural measures may occur as a result of FRS 7, which could conceivably prohibit the upstream migration of the sucker (family Catostomidae) beyond that point. Although Catostomidae species are known to migrate upstream to spawn, the extent of their movement up Duncan Creek has not been established. Thus, it is not known whether FRS 7 would adversely impact their habitat. Moreover, it may very well be that this family of fishes may readjust its spawning location to a position below the proposed structure without significant impact upon spawning habits.

We found no rare or endangered plant or animal species in areas that would be affected by the project.

The creation of additional water bodies would create new sport fishing locations to supplement existing locations. On the other hand, inundation will cause terrestrial habitat to be lost; the area available for upland game hunting will be reduced by 194 acres (surface area of sediment pool and floodwater pool). However, since current hunting pressure in the watershed is light,¹ the loss of 194 acres is not considered to be a significant impact.

Approximately 87 percent of the total flood plain area presently experiences recurrent floodwater damage. This damage occurs so frequently that landowners are not able to engage in the level of agricultural productivity that would yield the most practicable net returns. With the degree of protection provided by the project, a large portion of the flood plain acreage is expected to be used for row-crop production, within the limits of edaphic capabilities. It is estimated that flood plain enhancement will increase net returns on 3371 acres of flood plain which have been evaluated for more intensive utilization (Soil Conservation Service, 1974).

¹Since completing this study, we have been informed by the Kentucky Department of Fish and Wildlife Resources that hunting pressure on all small game species and raccoons is heavy in the watershed. The loss of 194 acres of land for hunting is more important under these conditions, but not of major significance.

Total structural measures are expected to provide the following beneficial impacts: (1) an \$80,500 reduction in annual damage to bridges, roads, crops, pasture, and other agricultural activities; (2) more intensive use of the land, valued at \$48,000 in annual benefits; (3) changes in the pattern of land use; (4) employment benefits valued at \$16,400 annually. Thus, the total average annual benefit expected to occur as a result of structural measures is \$173,500. The construction phase of the project will provide new employment opportunities and a percentage of the wages paid to the construction workers will be fed into local and regional economies.

The expected change in land use patterns will bring about an attendant increase in property valuation. It is probable that the local tax base will be expanded due to increased revenues generated from this projected increase in property values.

The FRS 7 impoundment and channel improvement will modify existing land use patterns. Present land use of dam and spillway areas, sediment pool area, flood pool areas, and altered channel area is as follows:

Structure Use	Present Land Use			
	Grassland	Cropland	Woodland	Other
Dam & Spillway (4 acres)	75% (3 acres)	-	25% (1 acre)	-
Sediment Pool (50 acres)	75% (37 acres)	-	25% (13 acres)	-
Flood Pool (110 acres)	70% (77 acres)		25% (28 acres)	5% (5 acres)
Channel Work (245 acres)	26% (63 acres)	32% (78 acres)	17% (42 acres)	25% (62 acres)
Total: 409 acres				

Assuming the worst possible case (i.e., that all 409 acres are capable of supporting agricultural activities), the FRS 7 impoundment and channel alteration project would remove 0.6 percent of watershed land from potentially productive agricultural acreage. However, land capabilities, market prices, and personal preference are all variables influencing the decision to bring a particular parcel of land into agricultural production. It is difficult, therefore, to assess the percentage of affected acreage that would conceivably be brought into productivity if inundation did not occur.

Certain secondary social benefits will accrue as the result of the increase to personal income. First, there will be a slight distention of purchase power, which gives minor stimulation to local and, to some

extent, regional markets. Second, the standard of living will be enhanced because of the new ability to obtain additional social services. Third, a sense of permanence and stability would replace the apprehension caused by recurrent flood damage to crops and pasture.

Three minority families live within the watershed. The planned project will not adversely affect these families.

The installation of structural measures will not result in the displacement of any person, business, or farm operation known to exist in the impact area. Stages in the floodwater retarding structure will inundate a barn and approximately 1,000 linear feet of farm road. The cost to remove the barn and relocate the road is estimated to be \$2000. It is not expected that relocation of the road will pose a significant inconvenience to travelers along that byway.

It appears that any impact on archeological remains would be insignificant. This is based on the data obtained in an archeological report on the land areas necessary for the installation of structural measures.

The following pages contain an itemized listing of the major environmental impacts associated with this project.

Favorable Environmental Effects

Implementation of the project is expected to have the following favorable impacts on the environment:

1. An increase in net returns from agricultural activities will be provided on 3371 acres of flood plain land. This would result from (a) reduction in the number of plantings per crop yield and (b) a reduction in the number of crop losses, from three crop losses every four years to one crop loss every four years.
2. A small number of temporary jobs will be provided during the construction phase of the project.
3. Local purchasing power would be distended, thereby raising the standard of living of those farmers owning land in the flood prevention area. This increased purchasing power will come from the additional income from increased crop yields. The increased income and consequent purchasing power will minimally boost the economy of the watershed area.
4. A sense of permanence and stability will be installed in the minds of flood plain residents by the decrease in disruption by floodwaters.
5. An increase in property value will be fostered in the flood plain area as a result of the increase in net returns on agricultural land in the flood plain.

6. Average annual floodwater and sediment damage will be reduced by 84 percent as a result of flood control.
7. Improved drainage and abatement of periodic inundations will make more land available for agricultural plantings of such crops as soybeans, tobacco, milo, and sorghum within the watershed.
8. Waterfowl feeding and resting habitat will be increased as 307 additional surface acres of water are created by reservoir construction.
9. Possible loss of young wildlife will be reduced on the 3371 acres of land previously subjected to yearly flooding. The protection of this land from annual flooding may allow some edge vegetation to become permanently established, thereby creating some wildlife habitat that is not subject to flooding. This could have a positive effect on wildlife such as quail.
10. The establishment of 307 acres of additional fish habitat provided by construction of FRS's with limited public access.
11. An additional 70 acres of fish habitat will be created in farm ponds (SCS, 1974).

Adverse Environmental Effects

Implementation of the project is expected to have the following adverse impacts on the environment:

1. Land use will be disrupted on 601 acres of grassland, cropland, and woodland in the watershed during the construction phase of the project.
2. A small number of watershed residents adjacent to the construction area will be temporarily inconvenienced during the construction of FRS 7 and during channel modification by construction noise and dust and the relocation of 1000 linear feet of farm road.
3. The loss of 194 acres of stream edge habitat, including modified areas, backwater areas, and 50 acres for a water impoundment will reduce the area available for hunting.
4. Forage and cover habitat in the construction area will be eliminated. Vegetative species providing wildlife forage and cover, such as pignut and shagbark hickories, american sycamore, boxelder, red maple, sugarberry, slipper and winged elms, white ash, pin, red and black oaks, and sweetgum will be planted in certain disturbed areas. Possible reductions in gray and fox squirrel populations could result from the temporary loss of hickory and oak vegetative species along the Big Muddy Creek (Table 36).

5. Soil moisture retention will be decreased in the construction area by the elimination of plants and accumulated organic layers. Decreased soil moisture retention would successionaly favor mesophytic plants (species requiring moderate moisture, such as black oak), at the demise of hydrophytic plants (species requiring excessive moisture). Such hydrophytic species include pin oak, red maple, and American sycamore. This successional direction would depend on seedling survival and specific physiological water needs of the individual species. A reduction in the organic layer could result in decreased soil fertility by interrupting nutrient cycling. (Soil fertility may also depend on the nutrient status of component soil types. Soil fertility reductions could be offset by fertilizer applications during the revegetation phase.)
6. Decreased soil fertility will result from the elimination of periodic inundation of the flood plain.
7. Successional patterns within Sampling Area 2 will be altered by improved drainage patterns. Hydrophytic species (pin oak and red maple) were observed to be the most important over-story and understory species of Sampling Area 2 (Tables 31 and 32). Drainage changes within in this area could direct successional trends toward more mesophytic species.
8. Soil erosion probability will be increased during channel modification by the removal of cover vegetation.
9. Terrestrial wildlife habitat will be permanently altered or eliminated. This includes:
 - a. Permanent loss of 963 acres of woodland to increased cultivation.
 - b. Loss of 2408 acres of pasture and oldfields to increased cultivation. This is viewed as adverse because these areas are the prime habitat of the small mammals, herptiles and arthropods that form the basis of the food chain. Increased cultivation is more harmful to this wildlife resource than flooding because habitat disturbance from intensive cultivation occurs on a year-round basis.
 - c. Permanent loss of terrestrial wildlife habitat in the floodwater retention dam location.
10. The area's carrying capability for wildlife will be permanently reduced as a result of abovementioned habitat destruction.
11. Competition pressures in the watershed will be increased as a result of the elimination and/or diversion of land used for nesting and cover.

12. Permanent emigration of wildlife such as the turkeys found within the study area will occur as a result of noise and human intrusion.
13. Ground cover (forage sources) will be temporarily eliminated during periodic maintenance for brush removal.
14. For the long-term, approximately 10 miles of stream will be altered by channel modification. This will reduce the fisheries productivity and value of the natural sections of Big Muddy Creek by disrupting fish habitat and food sources, but should have minimal effects on previously altered portions of the creek.
15. Long-term changes in the stream flow regime will be effected. Reduced flow during the late summer and early fall will result from retention of inflow by the FRS's on the major tributaries. Reduced stream flow may adversely affect water quality, food sources, and habitat essential to sustain positive fisheries productivity.
16. Summer water temperatures will be increased and DO levels decreased in the modified areas as a result of tree and stream-side vegetation removal. These changes could exceed state recommended levels and adversely affect sensitive game species.
17. Fish populations in the dredged portions of the Big Muddy Creek will be temporarily reduced either by direct destruction or by emigration of the fish from the affected area.
18. The stream ecosystem, especially the fish communities, will be impacted by recurring project maintenance practices in the form of reduced water quality, food sources, and habitat.
19. There will be a decrease in the assimilative capacity of the stream with the result that the pollutorial load (agricultural runoff) will be carried farther downstream.

ALTERNATIVES

The range of alternatives for flood damages reduction in a small agricultural watershed is limited, relative to those available in larger river basins and in suburban/urban areas. Nevertheless, a number of alternatives were considered for alleviating the flood problems in Big Muddy Creek; a discussion of these alternatives follows.

The alternative of no project was considered. Benefits from the partially completed land treatment program and the four installed FRS's would continue to occur. This alternative would eliminate the cost of structural modifications and any adverse effects caused by them. Flood damage would continue. Without the remaining project, \$228,150 of average annual benefits would not be realized.

1. Favorable Effects:

- a. 194 acres of terrestrial habitat would be left undisturbed for hunting purposes.
- b. There would be no inconvenience to watershed residents during the construction of FRS 7 or during channel work.
- c. Land use patterns would remain undisturbed.
- d. Habitat maintenance through natural succession would continue.
- e. Forage species for wildlife would continue to be maintained.
- f. Soil erosion would be decreased because of extensive cover vegetation.
- g. Carrying capacity for wildlife would not be reduced by effects of channel modification and use of idle land for crop production.
- h. Fish habitat improvement would continue in the previously altered portion of Big Muddy Creek through natural cutting and filling of the stream channel.

2. Adverse Effects:

- a. Floodwater damage to crops, pasture, roads, and bridges would continue.
- b. More intensive use of flood plain acreage and the attendant increase to agricultural productivity would not occur.
- c. Apprehension on the part of flood plain farmers, who are reluctant to plant in areas subject to continual flooding, would continue.
- d. Development for migratory waterfowl would not occur.
- e. Additional fishing waters (FRS's and farm ponds) would not be developed.

Accelerated land treatment only would reduce erosion and surface runoff to a limited extent and benefits from the four installed floodwater structures will continue to occur. The major flood problem downstream, particularly in the Green River backwater area, would continue. This alternative would improve the ecological conditions of the upland areas, improve wildlife habitat, and reduce erosion.

1. Favorable Effects:

- a. Accelerated technical assistance to specific agricultural problems confronting watershed landowners would continue.

- b. Terrestrial habitat would remain undisturbed, permitting continued use for hunting.
- c. Agricultural productivity would be somewhat increased.
- d. Stream siltation would be reduced, the result of soil stabilization in agricultural areas.

2. Adverse Effects:

- a. Floodwater damage to crops, pasture, road, and bridges would continue to occur.
- b. More intensive use of flood plain acreage and the attendant increase to agricultural productivity would not occur.
- c. Apprehension on the part of the flood plain farmers, who are reluctant to plant in areas subject to continual flooding, would continue.
- d. Competition for available habitat would increase due to the decreased carrying capacity resulting from brush removal.
- e. Possible increase in siltation where land use is modified, other than in streamside agricultural areas, depending on the nature of the activity.

Land treatment and FRS 7 only would further reduce erosion and surface runoff. Incremental annual benefits and costs for FRS 7 are \$9420 and \$9300 respectively. Adverse effects of the channel modifications would be avoided. Adverse effects of the floodwater problem would, in the main, continue.

1. Favorable Effects:

- a. Amount of floodwater damage occurring to crops and pasture would be reduced slightly.
- b. Accelerated technical aid to specific agricultural problems confronting watershed landowners would continue.
- c. Potential agricultural productivity would be increased.
- d. Habitat for migratory waterfowl would be increased.
- e. "Edge" habitats would be increased.
- f. Inundation losses would be reduced.
- g. Habitat for fishes would be increased.
- h. Slight reduction in stream siltation would occur.

2. Adverse Effects:

- a. Damage to crops and pasture would continue.
- b. Temporary inconvenience to watershed residents during construction of FRS 7.
- c. Vegetation successional patterns would be altered on effected land.
- d. Cover vegetation would be temporarily eliminated.
- e. Soil fertility may decrease as seasonal inundation ceases.
- f. Carrying capacity for wildlife would be reduced.
- g. Potential wildlife populations would be reduced.
- h. Competition for available forage and cover would increase.
- i. Some stream habitat would be converted to reservoir habitat.
- j. Upstream spawning migration of suckers (catastomids) may be blocked.

Channel clearing and snagging would have very little effect on flooding problems because the main problem is two-fold: excessive surface runoff and inadequate channel capacity. The effect of this alternative would approximate that of the "no project" alternative; however, there would be adverse environmental effect from increased erosion during clearing operations.

1. Favorable Effects:

- a. 194 acres of terrestrial habitat would be left undisturbed for hunting purposes.
- b. No inconvenience to watershed residents during the construction of FRS 7 or during channel modification because no construction or channel modification will occur, although some minor, limited inconvenience may be caused by clearing and snagging operations.
- c. Land use patterns would remain undisturbed.
- d. Floodwater damage to crops and pasture adjacent to channel due to water backup from log jams would cease.
- e. Agricultural productivity would be increased.

- f. Agricultural crop losses from inundation would be reduced.
- g. Habitat maintenance through natural succession would continue.
- h. Forage species for wildlife would continue to be maintained.
- i. Carrying capacity for wildlife would not be reduced by effect of channel modification and use of idle land for crop production.
- j. Wildlife losses due to flooding would be reduced.
- k. Fish habitat improvement would continue in the previously altered portion of Big Muddy Creek through natural cutting and filling of the stream channel.
- l. Fish movement, especially suckers (catastomids), would be facilitated during spawning migration.

2. Adverse Effects:

- a. Floodwater damage to crops, pasture, roads, and bridges would continue.
- b. More intensive use of flood plain acreage and the attendant increase to agricultural productivity would not occur.
- c. Apprehension on the part of flood plain farmers, who are reluctant to plant in areas subject to continual flooding, would continue.
- d. Cover and forage species along channel bank may be temporarily altered.
- e. Erosion potential would temporarily increase as a result of possible removal of cover vegetation.
- f. Terrestrial wildlife populations adjacent to channel may be decreased because of possible vegetation removal.
- g. Development for migratory waterfowl would not occur.
- h. Food chain "links" may be interrupted or eliminated during channel clearing, in which mussels and shellfish important to raccoons are removed or eliminated, thus depleting the food supply.
- i. Holes, riffle areas, and cover for fish would be lost.
- j. Food web organisms would be temporarily reduced or lost because of increased sediment levels during and after clearing and snagging operations.

- k. Carrying capacity would be reduced over the long-term.
- l. Additional fishing waters (FRS's and farm ponds) would not be developed.

Land treatment, FRS 7, and a 2-year channel modification program would provide a significant reduction of flood damages. Incremental annual benefits and costs for a 2-year channel structural program are \$65,000 and \$91,000 respectively, making overall project annual benefits and costs amount to \$74,820 and \$104,300. Adverse effects from channel modification would include ecological effects resulting from channel disturbance and downstream sedimentation (primarily during construction) reduced aesthetic values, and reduced stream aquatic ecologic values.

1. Favorable Effects:

- a. Net returns from agricultural activities in flood plain acreage would be increased.
- b. New employment opportunities would occur during construction phase of the project.
- c. Distended purchasing power would accrue from additional income from increased crop yields; this would increase the standard of living for watershed landowners.
- d. A sense of permanence and stability would be experienced by flood plain residents.
- e. Property values in the flood plain area would increase.
- f. Amount of annual floodwater and sediment damage of flood plain acreage would be decreased.
- g. Vegetative combustibles would be decreased.
- h. Potential agricultural productivity would increase.
- i. Conditions conducive to greater agricultural cultivation would be created.
- j. Vegetation losses to inundation would be decreased.
- k. Waterfowl habitat (resident and migratory) would be increased.
- l. New "edge" habitat would be created.
- m. Wildlife losses to inundation would be reduced.
- n. Fish habitat (farm ponds and FRS 7) would increase.

- o. Sediment damage to bottom organisms in upstream areas would be reduced.

2. Adverse Effects:

- a. A temporary inconvenience to watershed residents would occur during the construction of FRS and channel improvement.
- b. Terrestrial habitat acreage would be reduced, reducing the area available for hunting.
- c. Some cover and forage vegetation would be eliminated.
- d. Soil fertility resulting from lack of periodic inundation would be decreased.
- e. Successional patterns with Sampling Area 2 would be altered.
- f. Soil erosion probability would be increased during channel improvement resulting from removal of cover vegetation.
- g. 963 acres of woodland habitat would be permanently lost.
- h. 2408 acres of pasture and oldfield would be lost.
- i. Competition pressures, along with habitat destruction, would lead to a permanent decrease in wildlife populations.
- j. A long-term reduction of carrying capacity and overall value of Big Muddy Creek as aquatic habitat would occur.
- k. Long-term alteration of stream flow regime would occur.
- l. Habitat diversity would be decreased and conditions in the altered portion of Big Muddy Creek less favorable for the establishment of stable populations of large game fishes would be created.
- m. Temporary increase in summer water temperatures and a decrease in dissolved oxygen would occur.
- n. Benthic organisms would be temporarily lost because of increased sediment loads during and following construction.

A number of nonstructural measures are discussed below. A pervasive comment with respect to nearly all such measures is that flood damages and long-term erosion/sediment damage to downstream areas will continue.

Flood plain zoning can be an effective tool, particularly in areas of minimum development or in areas undergoing rapid development; however, in an existing agricultural area, zoning would not reduce flood damages. Zoning could be part of an overall watershed protection

program to guard against new developments in and any more intensive use of the flood plain. Also zoning discourages the false sense of security that a structural program can create.

No economical methods of floodproofing crops have been developed because of the extent of land involved. Floodproofing structures of certain types can be effective; however, in the Big Muddy Creek flood plain, few structures exist. Furthermore, major damages occur to the land itself.

Flood warning can be most effective in larger watersheds where adequate warning time is possible. Warning is only applicable to situations where, given adequate time, people and/or goods may be relocated. Again, in an agricultural watershed where the damages are to crops, generally during the growing season, and not to stored commodities, warning would be ineffective in reducing damages.

If all 4802 acres of flood plain land protected by the 5-year channel were purchased, the cost would be approximately \$2,401,000.¹ If the 3371 acres which are considered adaptable to either intensive or changed land uses were purchased, the cost would be approximately \$1,685,500.¹ Land purchase would reduce the farmable acreage, resulting in less farm income for each family unit, and may result in the voluntary relocation of many families in the flood plain because of the decrease to profitability. If the 3371 acres were not farmed, there would be an annual loss of \$241,100¹ to agricultural productivity in the watershed.

Flood insurance through the National Flood Insurance Program (provided for by the National Flood Insurance Act of 1968, as amended) does not cover flood damage to crops unless they are within a structure. Most of the damage in the watershed is during the cropping season, and very little, if any, occurs during storage. Also, at the present time crops grown in the flood plain cannot be insured against flood damages through the Federal Crop Insurance Corporation.

Ostensibly, all nonstructural measures would have the same effect as that of the no project alternative, including the following:

1. Favorable Effects:

- a. 194 acres of terrestrial habitat would be undisturbed for hunting.
- b. Watershed residents would not be inconvenienced during construction of FRS 7 or during channel work.
- c. Continued habitat maintenance through natural succession.
- d. Forage species utilized by wildlife would be maintained.

¹Based on 1974 land values.

- e. Soil fertility would be maintained by yearly inundations.
- f. Terrestrial wildlife habitats would be maintained.
- g. Bird and terrestrial forage supplies would be maintained.
- h. Carrying capacity for a diverse wildlife population would be maintained.
- i. Fish habitat would continue to improve in the previously altered portion of Big Muddy Creek through natural cutting and filling by the stream.
- j. Carrying capacity for fish would not be lost and present species diversity would be maintained.

2. Adverse Effects:

- a. Continued floodwater damage to crops, pasture, roads and bridges.
- b. More intensive use of flood plain acreage and the attendant increase to agricultural productivity would not occur.
- c. Apprehension on the part of flood plain farmers who are reluctant to plant in areas subject to continual flooding, would continue.
- d. Some seasonal species would be lost due to flooding.
- e. Migratory waterfowl habitat would not be developed.
- f. Additional fishing waters would not be developed.

Specifically, flood plain zoning would permit the annual inundations to occur within their normal seasonal periods. The environmental impacts of this alternative are similar to those impacts listed for the no project alternative. Such would also be the case for floodproofing, flood warning, and flood insurance, none of which are applicable in alleviating flood problems in the Big Muddy Creek Watershed. The environmental impacts of the land purchase alternative may be minimal but would be dependent on the nature and magnitude of any modifications in land use.

SHORT-TERM VS. LONG-TERM USE OF RESOURCES

In view of the current and historical tendency toward agricultural production in the watershed, and in view of the insignificance of residential, commercial, and industrial land use pressures, it must be concluded that enhancement of agricultural potential through implementation of the project can only serve to benefit present and future inhabitants of the watershed.

Completion of the proposed project would provide an immediate solution to the perennial problem of floodwater damage to flood plain acreage. The project would provide flood protection for practically all of the 4802 acres flooded by 5-year frequency storms; it would protect 1497 acres from the threat of 50-year frequency storms. This means that both short- and long-term uses of flood plain resources would be measurably enhanced.

Acreage devoted to the FRS 7 dam and reservoir is considered to be committed for the life of the project; consequently, this acreage would be lost for short-term uses. However, it is estimated that the long-term beneficial effect to the watershed provided by FRS 7 will outweigh the short-term benefit derived from current use of the land.

The project is considered to be compatible with long-term modifications of land and water resources. It will only serve to facilitate shifts in agricultural production, particularly shifts of crops from upland sloping areas to the essentially level flood plain.

The short-term environmental disturbance that will occur during construction and afterwards is significant but of relatively short duration. The loss of additional wildlife habitat to future clearing for expanding agricultural use in the flood plain will more significantly affect the long-term use of the wildlife resource in the watershed.

The design life of the project is planned to be 50 years. If the watershed program is properly applied and maintained, project measures are expected to continue to prove instrumental in the conservation of land and water resources beyond the planned life expectancy of the project.

Big Muddy Creek Watershed project is one of 13 project approved for operation in the Green River Basin under P.L. 566, as amended. In total, these 13 projects include 91 reservoirs and 186 miles of channel work and encompass 1325 square miles, or about 14 percent of the Green River Basin and about 5 percent of the Kentucky-Green River subregion, as delineated by the Water Resources Council. The 186 miles of authorized channel work represent about 2.3 percent of the total channel length in the Green River Basin.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible commitments of resources are defined as those environmental modifications induced by the proposed action that, at some later date, could not be altered to restore the pre-project ordering of these resources. Irretrievable commitments are generally resources used or consumed that are neither renewable nor recoverable for later use.

Resources that may generally be considered to be irreversibly committed by the project are: (1) construction materials that cannot be recovered and recycled, given present technology; (2) biological species and habitat destroyed or dislodged in the watershed; (3) land uses irreversibly committed for the life of project; (4) human resource utilization; and (5) capital investments.

Construction materials considered to be expendable include concrete, steel reinforcements, and various collars, fittings, and conduit used to build FRS 7. No arrangements have been made to recycle these materials when their intended use has terminated. In addition, the fuel used to power the machinery used during the construction phase will be irreversibly and irretrievably committed.

Execution of the project will result in the near elimination of approximately 754 acres of terrestrial and aquatic ecosystems in riparian communities in these areas, riparian wildlife species will be forced to emigrate to neighboring habitats, causing an imbalance in neighboring ecosystems. Although restoration of the riparian communities is possible, it must be considered highly unlikely, and therefore the elimination of this habitat must be considered an irreversible commitment of this resource.

The implementation of the project will result in conversion of 754 acres from present land use to constructed water impoundment structure and reservoir, and channel. Of this total, approximately 164 acres will be required for the FRS 7 dam and reservoir and would be considered permanently altered. Although restoration is possible, the considerable expense and effort required to bring about such a renovation must be questioned from the standpoint of feasibility. Therefore the acreage to be inundated by FRS 7 reservoir is considered irreversibly committed. Likewise, the acreage dedicated to the channel modification must also be considered irreversibly committed, and, thus, lost for agricultural purposes for the life of the project.

Human resources, unlike natural resources, cannot be stored for future use. Manhours spent on the watershed project are lost only in the sense that their utilization on other activities is precluded. The greatest loss of human resource would be nonuse or misuse. Regardless, the use of human resources on this project must be considered an irretrievable commitment.

Although there is an irreversible commitment of capital investments to the watershed project, it is deemed that project construction and maintenance costs will be indirectly retrieved through the beneficial control of floodwater damage throughout the flood plain, enabling a more successful and intensive use of the land.

CONSULTATION AND REVIEW WITH APPROPRIATE AGENCIES AND OTHERS

Increasing concern of landowners and community leaders about the magnitude of the flooding, sediment, and erosion problems resulted in an application for assistance. This application was submitted by the Butler and Logan County Conservation Districts and the Big Muddy Creek Watershed Conservancy District to the Soil Conservation Service through the state of Kentucky. Subsequent preliminary studies indicated that a feasible project could be formulated which would provide a suitable solution to these problems. Planning assistance was authorized

in March 1961. The work plan was approved in September 1962. Flood plain landowners voted favorably for a special assessment of \$1.00 per acre in January 1968. This revenue is being used to purchase land rights for structural measures. Concerned citizens, private and professional groups, and state and federal agencies cooperated with the sponsoring local organizations during project formulation. These included the Kentucky Department for Natural Resources and Environmental Protection, Department of Fish and Wildlife Resources, Division of Forestry, U.S. Army Corps of Engineers, Forest Service, U.S. Fish and Wildlife Service, and Farmers Home Administration. These agencies have been invited in writing to participate in the development of the current planned works of improvement for this statement. A public meeting was held in September 1974 as a part of the planning process. A notice of this meeting was published in the local papers. Incremental portions of the project remaining to be installed were reevaluated in 1974. This reevaluation resulted in redesigning the channel work to include construction techniques that will reduce adverse effect on the environment. These techniques were developed in cooperation with the U.S. Fish and Wildlife Service and the Kentucky Department of Fish and Wildlife Resources.

The National Register of Historic Places does not list any historic places in the project area. The Service has consulted with the State Historical Preservation officer concerning historic places in the project area. The Bethel Baptist Church is listed as a historic site by the Kentucky Heritage Commission within the project area. This site will not be affected.

The Museum of Anthropology, University of Kentucky, has made an archeological study of the areas required for the construction of structural measures. The state archeologist has reviewed this study and is in agreement with the findings.

As a result of comments received during the draft EIS review concerning the possible existence of some darter species that may be on the national endangered or threatened species list, the Kentucky Department of Fish and Wildlife Resources conducted additional sampling of Big Muddy Creek. No species of darter was found that is presently on the national list. However, the mud darter (Etheostoma aspringene) which, at that time, was on the state's list of rare and threatened species was found during two sampling periods, November 1975 and 1976.

Much time and effort has been expended in data search to determine the distribution and exact habitat requirement by both SCS and the Department of Fish and Wildlife Resources. Although the mud darter does not appear to have wide distribution in Kentucky, it is a fairly common species of darter in the states south of Kentucky. Its habitat requirements appear to be quite variable.

Although the Department of Fish and Wildlife Resources is opposed to channel modification as a principle, they and U.S. Fish and Wildlife Service have assisted SCS in the planning and designing of channel work to reduce the adverse effects on fish and wildlife resources. This cooperation is reflected in the revised channel design described in the planned project section.

Section VII of the Endangered Species Act as revised in November 1978 has been complied with.

The following agencies have provided comments on the draft environmental impact statement:

Kentucky Department of Fish and Wildlife Resources
Tradewater River Audubon Society
U. S. Department of Agriculture, Office of Equal Opportunity
U. S. Environmental Protectional Agency
Department of the Army, Louisville District Corps of Engineers
U. S. Department of the Interior
Kentucky Department for Natural Resources and Environmental Protection
Advisory Council on Historic Preservation - Washington, D. C.
Department of Transportation, U. S. Coast Guard
U. S. Department of Health, Education, and Welfare

COMMENTS AND RESPONSES TO THE DRAFT ENVIRONMENTAL IMPACT STATEMENT

Kentucky Department of Fish and Wildlife Resources

Page 6. Pertinent information which has been omitted includes the dimensions of the excavated channel, gradient of the channel bed after excavation, and the dimensions of the levees.

Response: The Planned Project Section has been rewritten to include much of this information. (See Page 3.)

Page 10, Section 7. Specific information and drawings of the proposed mitigatory structures should be included in this E.I.S. This would include information concerning the number and placement of proposed low dams and jetties and their dimensions.

Response: The Planned Project Section has been rewritten to include more specific data.

Pages 59-60. There is discontinuity between pages 59-60.

Response: This has been corrected.

Page 65. "With increasing numbers of fishermen, the available fisheries resources can be expected to receive additional fishing pressure in the future."

With channelization, this will not be the case with the Big Muddy Creek channel, as the sport fishery will be virtually destroyed as will be the aesthetic values so important to fishermen.

Response: Local people do not believe that this stream is an important sport fishery. This statement is supported by the Butler County Conservation Club, as indicated in a letter to the

Watershed Conservancy District, a copy of which is included in Appendix C.

Page 75. "The storm condition results in abnormal floodwater damages to crops and pasture and other agricultural improvements in the flood plain."

We question the use of the word "abnormal." There is nothing "abnormal" about floodwaters occurring on flood plains. The designation of the proposed project as a 5-year protection plan alludes to a flood or a proportion expected to normally occur once every 5 years.

Response: We agree. Abnormal has been removed.

Page 77. "It is estimated that annual sediment damage to the Big Muddy Creek channel is \$13,300."

What criteria were used to formulate this estimate? It has been documented that sedimentation is extremely damaging to aquatic organisms, however, since at no place in this E.I.S. has any monetary worth been assigned to existing fish and wildlife resources which will be destroyed, we doubt that this figure represents damage to the existing aquatic resources. Since the existing channel has not been maintained "since about 1941," this figure would not realistically represent annual channel maintenance costs.

Response: This estimate is based on calculations of sediment deposit and the annual average cost of removing this amount of sediment. Monetary values have not been applied to wildlife and fish resources in this report; instead, these resources have been assigned qualitative values. Moreover, because this channel was modified in the 20's and there was no resulting permanent damage to the wildlife resources, we believe there will be only temporary damages again.

Page 83, paragraph 1. " . . . should result in rapid establishment of the minimal fisheries now present in the modified section."

It has taken approximately 45 years for the alleged "minimal" fisheries to become reestablished in the previously modified channel. "Rapid" establishment after this proposed remodification is unrealistic.

Response: "Rapid" has been changed in the text to "gradual."

Page 83, paragraph 3. "However, if both sides are denuded, a minimum of 5 years will be needed for growth of adequate cover."

Adequate cover cannot possibly become established in 5 years. It would take 20 to 30 years for the fastest growing trees to grow large enough to provide any significant shade; and if the channel is maintained so as to accomplish its purpose, adequate shade will never occur, as maintenance procedures would prevent woody vegetative growth on the channel edge. Trees planted on the spoil bank are not close enough to the channel to provide shade.

Response: "Adequate cover" as used in this report refers to any vegetation cover which would develop sufficiently and produce a fine root network capable of preventing bank failure and side erosion. Species useful for this purpose would include a variety of grasses and shrubs which occur locally within the vicinity of the Big Muddy Creek Watershed.

Page 85. "It is currently impossible to determine the absolute number of mobile wildlife that would emigrate or of sedentary wildlife that would perish as the result of channel modification."

Current wildlife investigational techniques permit close estimation of wildlife populations through an evaluation of existing habitat conditions (carrying capacity), which can then be compared with estimates using projected habitat conditions after project completion and land-use changes have accrued. This would give a reasonable estimation of the loss or gain in numbers of wildlife as a result of channel modification. This should be done before the project proceeds further.

Response: Because the adverse impact to wildlife of construction of FRS 7 and of channel modification will not be significant, numerical estimates of the number of wildlife directly impacted have not been made. Additional qualitative information has been added to the text in section Environmental Impact, Structural Measures.

Page 86, paragraph 2. This paragraph contradicts the statement on page 60, paragraph 3, that the Longhead Darter, an Endangered Species, was found in Big Muddy Creek in 1961-63 by Dr Sisk. Extensive and intensive sampling should be conducted to determine if this species still exists in the stream, and if found, all efforts be made to preserve its habitat.

Response: The sampling program conducted for the SCS by Dames & Moore in 1974 was both extensive and intensive enough to determine if the longhead darter was present in the project area. The sampling did not reveal the presence of this species. Dr. Sisk's sampling in 1961-63 was conducted in a county adjacent to the counties in which the proposed project is located. Subsequent sampling by Department of Fish and Wildlife Resources has confirmed that the longhead darter is not present nor are other endangered species.

Page 86, paragraph 3. Current hunting pressure in the watershed is described as light. The Department of Fish and Wildlife Resources survey of this area indicates that hunting pressure is heavy on all small game species and raccoons.

Response: The information on the current hunting pressure in the watershed was obtained from the regional state game biologist for the Big Muddy area. We have added the information contained in your comment to the text.

Page 92, paragraph 9. An increase in waterfowl feeding and resting habitat is listed as a favorable environment effect; yet the loss of wood duck nesting and brood habitat which is far more important in this area, is not listed under adverse environmental effects.

Response: There is no known wood duck nesting and brood habitat in this area of Kentucky.

Page 93, paragraph 4. Forage and cover habitat for wildlife species now occurring will be permanently, not temporarily, destroyed. Wildlife forage and cover plantings in the past have not been adequately established or maintained. Kentucky 31 fescue, a very poor wildlife plant, is the only cover normally seen on denuded areas. Also, the removal of hickory and oak vegetation along the stream will result in the elimination of gray and fox squirrel in the areas cleared, and cause population reductions in adjacent areas due to the reduction in food supply.

Response: The Adverse Environmental Effects of the text has been revised to reflect the thoughts in this comment.

Page 95, Section 8. "Erosion hazards for component soil types are not presently available in soil manuals of the respective counties."

On page 7, it is stated, "Constructed channels will be through a low-plastic, fine-grained soil (ML and CL according to the Unified Soil Classification system; reference ASTM D 2487)."

Surely the Soil Conservation Service has some idea of the inherent erosional capabilities of these component soils. Also pertinent would be estimates of the annual sediment load of the Big Muddy Creek before and after the proposed channelization.

Response: The statement concerning erosion hazards and soils has been deleted.

Several adverse environmental effects were not considered at all. The greater value of bottomland is mentioned in the watershed description, but the fact that these areas are valuable because of frequent flooding is not mentioned. Reduction of flooding can ultimately result only in a decrease of fertility and therefore of land value. This decrease in fertility can be counteracted only by increasing the use of commercial fertilizers. The supply of fertilizers has become limited in recent years, and their use must be considered a temporary measure and an irretrievable commitment of resources.

Response: Generally, it is accepted that seasonal flooding does provide silt and organic material to the flood plain area, increasing the fertility of that area. However, seasonal flooding also causes a loss in the total growing season as cropland vegetation does not grow well when inundated or silt coated.

At one time, agricultural practices were essentially extractive, involving no soil replenishment. In more recent time, rotational farming - including addition of legume crops and other "green" fertilizers - has in many instances increased the natural soil fertility with seasonal flooding. Because these crops would also be adversely affected by flooding, the reduction in flooding that would allow them a better growing season tends to help balance out the loss of fertility caused by reduced flooding.

As a resource in itself, the fertilizer used to grow crops in the flood plain would be considered an irretrievable commitment of resources. However, fertilizer can be considered a retrievable resource in the sense that it provides added plant growth, vigor and yield.

No mention is made of the effects of the project on water tables and groundwater recharge. Channelization invariably results in lowering of both, the amount varying with the region. A U.S. Geological Survey report on drainage in the Arkansas Delta region states that "water tables have declined throughout 89% of an area in eastern Arkansas which extends from the Missouri line to Desha County, and underground water levels have receded as much as 10 to 20 feet below former levels." Studies of this type are necessary for western Kentucky, where wells furnish an important domestic water supply, before further drainage is initiated.

Response: Widening (as opposed to deepening) of the channel, which is the activity primarily proposed in the channel modification work for the Big Muddy, will have an insignificant effect on water tables and ground water recharge in the project area.

An adverse effect which occurs outside the project area, and is therefore usually ignored, is downstream flooding. Quoting from the Linsley study (1949), "The removal of restrictions (channelization) makes for lower stages and faster getaway of the water upstream. This also results in a faster delivery of water to downstream points. The reduction in channel storage by shortening the channel and reducing upstream stages can serve only to increase peak rates of flow below the project reach." Quoting from the Lane Study (1947), "Downstream flooding has been caused by channelization of the Sangamon River in Illinois and the Wyconda, Fox, and Salt rivers in Missouri." This increase in flow and velocity also increases downstream silting, which in turn increases pollution because the silt acts as a vehicle for transporting many chemical pesticides and fertilizer elements. These elements are also increased by the need for heavy fertilization to counteract loss of inherent soil fertility due to elimination of upstream flooding.

Reponse: The drainage area of Green River above the mouth of Big Muddy is 5,616 square miles, as compared to the drainage area of Big Muddy which is 102 square miles. The bankfull capacity of Big Muddy at the mouth is planned for 6,500 cfs while Green River at Lock 4 has a record discharge of 205,000 cubic feet per second and a maximum discharge of 68,000 cubic feet per second for the

5-year period of 1970-1974. These facts indicate that the described discharges from Big Muddy will have little effect on stages in Green River.

Another adverse effect not mentioned is the loss of filtering of nutrients during overflow periods, which will no longer occur. This causes eutrophication downstream, as well as decreasing water quality and increasing the cost of water treatment for public consumption and industry.

Response: Page 94, items #5 and 6, addresses loss of nutrient addition to soil due to flooding.

Flooding of fertilized fields is more likely to lead to eutrophication than nonflooding. The additional FRS will also trap some of the sediments that would have been deposited on the land.

Changes in water quality will vary; certain aspects of the project will improve water quality and others will decrease water quality, resulting in a balance. The FRS sediment pools will reduce downstream sediment loads as will also land treatment, which will reduce erosion. FRS's will tend to extend base flow in dry periods. However, sediment loads will not be deposited (trapped) on the flood plain and will probably cause a short-term decrease in water quality with the associated cost of increased water treatment.

This impact statement is somewhat confusing in regard to benefit-cost ratios. Presumably, this E.I.S. would address itself only to those land treatment and structural measures that are yet to be installed; however, average annual benefits for structural measures (Appendix A) are evidently computed incorporating all five floodwater retarding structures, four of which are already in operation. Compounding the confusion are statements such as the following (page 98):

"Without the remaining project, \$228,150 of average annual benefits would not be realized."

This is the same figure that is claimed for all five floodwater retarding structures and channel modifications in Appendix A. This situation could easily be clarified if only those benefits and costs of the remaining structural and land treatment measures were included in this E.I.S. In this same regard, more detailed information is needed in this E.I.S. concerning the derivation of the figures (especially those of benefits) that were included in the benefit-cost ratios.

Response: The text throughout the report has been standardized concerning impacts in the following manner: (1) where the impacts of the total project cannot be meaningfully separated from the impacts of FRS 7 and channel works, the impacts of the total project are addressed; (2) where it is important that only those impacts that have not yet occurred be addressed, this has been done. In both cases, the text should clearly indicate whether the total project or the work still to be completed is being considered.

An area not covered by the cost-benefit formula is the net loss or gain in monetary values from changes in available hunting and fishing opportunity. The value of a hunter-day and fisherman-day have been established by the U.S. Fish and Wildlife Service and the Department of Fish and Wildlife Resources, among others. This net change should be calculated from the aforementioned analysis of changes in numbers of game species through habitat evaluation, and incorporated into the cost-benefit formula.

Response: The SCS cannot claim recreation benefits for this project, as no recreation management or recreation planning is involved in the proposed project.

Tradewater River Audubon Society

After studying the impact statement, it is our strong conviction that the project is unsound, both from an environmental and economic standpoint.

Response: This project has been evaluated according to current U.S. Department of Agriculture policy for evaluating water resource projects. Both environmental and economic considerations have been carefully weighed. In our judgment, the project is a sound one.

First, we feel that too much emphasis has been placed on the economic value of this project to the area, when actually very little economic benefit would result to the area except possibly to the landowners in the flood planes [sic], whose land would increase in value dramatically, at the expense of all taxpayers.

Response: The stated purpose of the project is to provide watershed protection and to increase the agricultural potential of flood plain acreage. It is true that this project is not a massive economic redevelopment program, but it will result in an increase in agricultural productivity. It is also true that the project will primarily affect the landowners and tenant farmers engaged in agricultural activities in the flood plain area. However, watershed projects such as this provide protection for the resource base and improve the quality of the human environment, often providing benefits exceeding those that are planned.

The loss of 963 acres of woodland and 2408 acres of pasture and old fields should be enough to defeat this whole project, and the benefit and cost comparison table seems to contain some overlapping of benefits, making an unrealistic benefit/cost ratio of 1.6 to 1.0.

Response: Congress requires that a cost/benefit ratio be calculated. This ratio must exceed 1:1 before project can be installed. The benefits defined are eligible under P.L. 566 and have been calculated under SCS policy according to appropriate guidelines. The factors mentioned have been considered in our analysis.

Also, the amortization figure of 2-5/8 percent is far too low under present inflationary conditions and high interest rates, and this percentage is entirely unrealistic.

Response: The interest rate used to evaluate this project is set by law and is based upon long-term government interest rates. This rate was approved by Congress.

Even by the figures contained in the impact statement, there will be a tremendous loss of wildlife and wildlife habitat.

Response: Our impact analysis indicates that 963 acres of woodland and 2408 acres of pastureland and oldfields will be lost to increased cultivation and 50 acres to the FRS pond. While this loss of wildlife habitat is permanent, it is not considered to be "tremendous." Although some wildlife will be adversely affected by the project, others will benefit. We believe this is adequately explained in the Plant and Animal Resource section of the text.

The pollutants which enter the Green River are a major concern to populated areas which must draw water from Green River. This water is already of poor quality, and completion of this project will add a significant amount of pollutants to the River.

Response: While the project will have some effect on the water quality of Big Muddy Creek, the amount of deterioration (described in the impact section) is not significant, and would therefore not constitute a significant pollution addition to the Green River.

In recent years channelization of our streams and rivers has increased so rapidly and with such disastrous results that we cannot view the channelization of a river of [sic] stream as one single project, but must weigh the results of all channelization of all our streams, and take into consideration further plans for channelization. While certain individuals might not view channelization of one stream as catastrophic, the cumulative results of these projects are disastrous, and these results have been well documented.

Response: There are 13 projects approved for operation under authority of P.L. 566, as amended, within the Green River basin. These 13 projects, including 91 reservoirs and 186 miles of channel work cover 1,325 square miles or about 14 percent of the Green River basin, and about 5 percent of the Kentucky-Green River subregion, as delineated by the Water Resources Council. The 186 miles of authorized channel work are 2.3 percent of 8,227 miles of channel in the Green River basin.

U.S. Department of Agriculture, Office of Equal Opportunity

It is recommended that the final draft include an assessment of the social and economic impacts of impending changes in the watershed on the minority population.

Reponse: None of Butler County's minority population reside in the watershed. There are three Logan County minority families living in the southern portion of the watershed, but they are located in the upland portion of the watershed. Since primary impacts resulting from the project will principally affect watershed residents in the flood plain region, it is not anticipated that persons living outside of the flood plain will be significantly affected. However, it is possible that a portion of the minority population in Butler and Logan Counties may benefit from the small number of temporary jobs that will be generated as a result of construction activities.

United States Environmental Protection Agency

Letter of September 9, 1974. The assessment should identify any adverse effects (degradation of water quality, etc.) that will result from specific actions and measures that will be taken to prevent or minimize degradation (early seeding or other cover for scarified land, sediment traps, etc.).

Response: The Soil Conservation Service will as a matter of policy take all actions necessary to prevent negative impacts resulting from specific action and measures. The text addresses actions to minimize degradation (See page 3).

The assessment should also identify who will be responsible for such protective measures and specify responsibilities for correcting and providing reparations for damages resulting from failure to follow programmed procedures.

Response: The Soil Conservation Service will develop designs and specifications which incorporate protective measures and will predicate financial assistance on compliance with designs. Those items considered normal operation and maintenance the sponsors will repair under an O&M agreement to be signed before project is installed.

Letter of September 29, 1975. The Summary Sheet at the beginning of the EIS should include the following:

- j. There will be a decrease in the assimilative capacity of the stream as a result of the channelization, and the polluttional load will be carried farther downstream.
- k. There will be an overall degradation in water quality values, including higher stream temperatures and lower DO values.

And on page 98, add the following additional adverse environmental effect:

- 20. There will be a decrease in the assimilative capacity of the stream with the result that the polluttional load will be carried farther downstream.

Response: These additions have been made.

Department of the Army, Louisville District, Corps of Engineers

It was noted . . . that a reference was made on page 18 to Regulation WP-4-1. This regulation has been superseded by 401 KAR 5:025, effective 2 July 1975. It is suggested that this latter regulation be incorporated in the Final Environmental Impact Statement.

Response: This section of the EIS has been deleted.

We would also like to point out that the project will require a Department of the Army Section 404 Permit if the proposed activity is not completed before 1 July 1976.

Response: The required permits will be obtained prior to construction.

United States Department of the Interior

General Comments:

The draft statement contains no information on groundwater resources or evaluation of impacts of the proposed project on such resources. At least a brief summary of the occurrence of groundwater and aquifer characteristics as well as an indication of the relative significance and magnitude of use of groundwater in the project area should be included. Impacts such as those resulting from changes in streamflow below impoundments or the flooding of areas above structures should be addressed.

Response: This information has now been supplied. There will be no significant impact on ground water levels as a result of this project.

The No. 4 Coal Bed (western Kentucky), situated near but above the valley floor in the northern part of the area of channel modification, has been extensively strip mined, however, the project is unlikely to conflict with similar mining of remaining coal. The potential conflict of the channel modification with oil wells located on the valley floor cannot be definitely determined because of the scale of the map in the report.

Response: Channel modification will not conflict with oil wells located on the valley floor.

Although the section on Environmental Impact, page 81, does not discuss minerals, it is believed that they should not be significantly affected by the project. The statement, however, should include some analysis of impacts if the project affects oil production.

Response: The project will not affect oil production.

The statement recognizes damages to fish and wildlife resources in a general manner but falls short of the full disclosure of these impacts. Although measures are included to reduce losses associated with stream channel alteration as a result of review procedures dictated by Soil

Conservation Service Watersheds Memorandum 108, we believe environmental damages remain at a significant level. Accordingly, the Department's Fish and Wildlife Service plans to reevaluate the proposed stream channel works and effects to fish and wildlife resources and submit a report to the State Conservationist in December 1975, to supercede [sic] the official letter report dated April 3, 1962. This forthcoming report will consider stream channel alteration effects to fish and wildlife resources under existing policy and will contain recommendations to satisfactorily reduce fish and wildlife losses.

Response: This letter dated January 2, 1976, contained no additional data. It said "In summary, the Fish and Wildlife Service in support of the Kentucky Department of Fish and Wildlife Resources cannot condone the construction of this project as planned until such a time that the Soil Conservation Service has satisfactorily resolved with the State all related environmental concerns" The efforts made to resolve these issues with the State and decisions reached are now described in the section of the text, Consultation and Review.

Specific Comments:

Pages 6 and 7. The plan of channel modification is divided into three parts with each part being further divided. The description of these plans should be expanded and presented in greater detail. As presented it is difficult to envision effect to stream ecosystems.

Response: The Planned Project Section of text has been rewritten.

Page 10, item #7. Specifics such as placement, materials, functions, etc., should be included to enable evaluation of "low dams, jetties, etc." in reestablishing pool and riffle habitat.

Response: Planned Project Section has been rewritten (see page 3). Specifics were established in consultation with state and federal wildlife agency representatives.

Page 67, paragraph 1. This paragraph concerns endangered fishes as listed in the Federal Register (Vol. 39, No. 3, January 4, 1974). This reference should be changed to United States List of Endangered Fauna (May 1974). There should also be a statement noting that the Department of the Interior has advertised a status review of several fishes in the Federal Register, Vol. 40, No. 53, (March 18, 1975), to determine if they should be proposed for listing as endangered or threatened species. These included the Eastern sand darter, Ammocrypta pellucida, and the longhead darter, Percina macrocephala, both of which has been collected in Big Muddy Creek.

Response: Reference has been changed. The Big Muddy Creek reference is to Ohio County.

Page 75, paragraph 3, Floodwater Damages. Although flooding is discussed as a problem, the statement fails to recognize overbank

flooding as a natural phenomenon which enhances the growth of hardwoods, increases the productivity of many wildlife species such as squirrel, raccoon, opossum, wood duck, woodcock, various song birds, and provides spawning and foraging areas for resident fishes. The statement should discuss the effects of altered flow regimens on fish and wildlife resources.

Response: Basically the question consists of two parts: (1) statement of the decrease in productivity of the streamside habitat in the absence of periodic inundation, and (2) discussion of altered flow regimes.

In reply to part 1 of the question, of the summary sheet refers specifically to periodic flooding of the watershed as a major problem within the region. Page 23, paragraph 4 discusses the productivity of the wetlands of the watershed and states that little or no wetland vegetation in the watershed is currently attractive to migratory ducks and other waterfowl. Therefore, the productivity of the seasonally flooded flats and basins is relatively low for avifauna. Terrestrial animals are discussed in detail on page 24, paragraph 7, which states that there is an abundant wildlife browse within the watershed (i.e., high productivity-carrying capacity). On page 25, paragraph 2, it is stated that the streamside edge habitat is an important watershed habitat, and paragraph 3 discusses the abundant muskrat habitat. Page 28 states that browse is plentiful along hedgerows, in the narrow belt of trees growing along the creek, and in other edge habitats. Further the bottomland and upland forests provide important cover for deer throughout the year. Page 28 discusses the abundance of cover from edge habitat as an important factor contributing to the abundance of cottontail rabbits. Page 38 discusses the plant and animal problems specifically related to periodic inundation. Page 44, item #4 relates the adverse influence of the project in reducing the overbank flooding and identifies species sensitive to or eliminated by the proposed action. Page 45, item #6 also discusses the decreased soil fertility resulting from the elimination of periodic inundation by the proposed action. Page 45, item #10 discusses the decrease in productivity (carrying capacity) due to riparian habitat destruction.

Part 2 of the question refers to the effects of altered flow regimes on both fish and wildlife resources. Page 39 discusses the effects of altered flow regimes on the plant and animal resources of the watershed. Page 41 discusses in specific detail the effects of altered flow on fish.

Therefore, it is felt both the productivity and the effect of altered flow regime questions have been adequately covered in sufficient detail for evaluation of this facet of the environmental statement for the Big Muddy Creek Watershed project.

Page 85. We agree that it is currently impossible to determine absolute number of wildlife that would be affected by elimination of riparian habitat. However current technology exists for making reasonable estimates, and this should be presented in the final statement.

Response: See reponse to similar comment from the Kentucky Department of Fish and Wildlife Resources. Additional qualitative has been added to the text section of Environmental Impact Information Structural Measures.

Page 93, item 4. The statement that forage and cover habitat will be temporarily eliminated is not true. Maintenance of altered stream channels require that berms and channel-side slopes be kept clean. Although total losses will be somewhat reduced by plantings of value to wildlife along a portion of the cleared right-of-way, woody vegetation, as described in the paragraph, will be permanently altered. We suggest that this item be quantified.

Response: All vegetation will be temporarily cleared in the construction area, but not the total work area. Maintenance requirement will in all probability preclude the growth of woody streamside vegetation.

The final statement should contain the comments of the State Historic Preservation Officer.

Response: We agree a copy of letter is being included in Appendix C.

Department for Natural Resources and Environmental Protection

It appears that three highway structures, two on KY 1153 and one on KY 1187 are within the proposed channel improvement. Are these structures affected by this channel improvement project?

Response: These highways cross the channel. Work to be performed will be coordinated with Highway Department before construction begins.

We note that flood retaining structure No. 7 which remains to be constructed will inundate Logan County Road No. CR 1068, the Anderson Store Road. Inundation of this road should be coordinated with the Logan County Fiscal Court.

Response: Inundation of this road will be coordinated with the Logan County Fiscal Court as a part of land acquisition for the project.

Advisory Council on Historic Preservation: Washington, D. C.

To insure a comprehensive review of historical, cultural, archeological, and architectural resources, the Advisory Council suggests that the environmental statement contain evidence of contact with the appropriate State Historic Preservation Officer and that a copy of her comments concerning the effects of the undertaking upon these resources be included in the environmental statement.

Response: We agree and the letter is included in appendix C.

United States Coast Guard

The Department of Transportation has reviewed the material submitted. We have no comments to offer nor do we have any objection to this project.

Response: None is required.

Department of Health, Education, and Welfare

We have reviewed the subject draft Environmental Impact Statement. Based upon the data contained in the draft, it is our opinion that the proposed action will have only a minor impact upon the human environment within the scope of this Department's review. The impact statements have been adequately addressed for our comments.

Response: No response is required.

LIST OF APPENDICES

APPENDIX A - Comparison of Benefits and Costs for Structural Measures

APPENDIX B - Project Map

APPENDIX C - Letter of Comments Received on the Draft Environmental
Statement

APPENDIX D - Sampling Locations and Tables

APPENDIX E - Literature Cited

APPENDIX F - Glossary

APPENDIX G - Structure Data, Channels for Flood Prevention

APPENDIX A

COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Big Muddy Creek Watershed, Kentucky

(Dollars)¹

Average Annual Benefits

Evaluation Unit	Damage Reduction	Average Annual Benefits			Employment	Total	Average Annual Cost	Benefit Cost Ratio
		More Intensive Land Use	Changed Land Use					
Five Floodwater Retarding Structures and 92,200 L. Ft. of Channel Work	80,500	48,000	37,000		8000	173,500	142,500	1.2:1.0
Grand Total	80,500	48,000	37,000		8000	173,500	142,500	1.2:1.0

¹Price base: Benefits- Crop and Pastures- current normalized prices, October 1978; all other benefits, 1978 prices. Costs- As built costs for completed structures and 1979 prices for remaining structures (No. 7) and channel work. Amortization period, 50 years at 3-1/4 percent.

PROJECT MAP
BIG MUDDY CREEK WATERSHED
BUTLER AND LOGAN COUNTIES, KENTUCKY
DRAINAGE AREA 65,140 ACRES



JOHN S. HOFFMAN
SECRETARY



JULIAN M. CARROLL
GOVERNOR

COMMONWEALTH OF KENTUCKY
DEPARTMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION
OFFICE OF THE SECRETARY
FRANKFORT, KENTUCKY 40601
TELEPHONE (502) 564-3350

September 10, 1975

U.S. Dept. of Agriculture
Soil Conservation Services
333 Waller Avenue
Lexington, Kentucky 40504

Subject: Big Muddy Creek Watershed, Butler and Logan Counties, Kentucky
(EIS 75-22)

Gentlemen:

The Kentucky Environmental Review Agencies have reviewed the above-mentioned draft environmental impact statement and, as a result of the review, have some comments to offer on this proposed project.

The Kentucky Department of Transportation comments are as follows:

It appears that three highway structures, two on Ky 1153 and one on Ky 1187 are within the proposed channel improvement. Are these structures affected by this channel improvement project?

We note that flood retaining structure No. 7 which remains to be constructed will inundate Logan County Road No. CR 1068, the Anderson Store Road. Inundation of this road should be coordinated with the Logan County Fiscal Court.

The Kentucky Department of Fish and Wildlife Resources comments of this environmental impact statement are attached to this letter in the form of a letter to me from Commissioner Arnold L. Mitchell.

Should there be any late comments on this project, they will be forwarded to you.

Sincerely and respectfully,

A handwritten signature in cursive script, reading "John S. Hoffman".
JOHN S. HOFFMAN
Secretary

JSH:HPH:jb

Enclosure

FISH & WILDLIFE
COMMISSION
BY DISTRICTS

1ST - DR DONALD L. BOUCHER PADUCAH
2ND - ERNEST C. NEIL SCOTTSVILLE
3RD - WALE MURPHY LT. EVILLE
4TH - DR JAMES C. SALATO COLUMBIA
5TH - DR K. E. LANTIER UNION
6TH - CHARLES E. PALMER JR. LEXINGTON
7TH - DR C. L. ALLEN MARTIN
8TH - DR ROBERT C. WEBB SPRAYSON
9TH - JAMES MCGILVERY BAXTER



OFFICE OF
PLANNING AND RESEARCH

APPENDIX C

CAPITAL PLAZA TOWER
FRANKFORT, KY. 40601
PHONE 564-3400

COMMONWEALTH OF KENTUCKY
DEPARTMENT OF FISH & WILDLIFE RESOURCES
ARNOLD L. MITCHELL, COMMISSIONER

August 25, 1975

Mr. John S. Hoffman, Secretary
Department for Natural Resources
and Environmental Protection
6th Floor, Capitol Plaza Tower
Frankfort, Kentucky 40601

Re: (Draft) Environmental Impact Statement -
Big Muddy Creek Watershed, Butler and
Logan counties, Kentucky

Dear Mr. Hoffman:

Members of my staff have reviewed the Big Muddy Creek Watershed impact statement and have the following comments:

Page 6 . . . Pertinent information which has been omitted includes the dimensions of the excavated channel, gradient of the channel bed after excavation, and the dimensions of the levees.

Page 10, Section 7 . . . Specific information and drawings of the proposed mitigatory structures should be included in this E.I.S. This would include information concerning the number and placement of proposed low dams and jetties and their dimensions.

Pages 59-60 . . . There is discontinuity between pages 59 and 60.

Page 65 . . . "With increasing numbers of fishermen, the available fisheries resources can be expected to receive additional fishing pressure in the future."

With channelization, this will not be the case with the Big Muddy Creek channel, as the sport fishery will be virtually destroyed as will be the aesthetic values so important to fishermen.

Page 75 . . . "The storm condition results in abnormal floodwater damages to crops and pasture and other agricultural improvements in the floodplain."

We question the use of the word "abnormal." There is nothing "abnormal" about floodwaters occurring on floodplains. The designation of the proposed project as a 5-year protection plan alludes to a flood of a proportion expected to normally occur once every 5 years.

August 25, 1975

Page 77 . . . "It is estimated that annual sediment damage to the Big Muddy Creek channel is \$13,300."

What criteria were used to formulate this estimate? It has been documented that sedimentation is extremely damaging to aquatic organisms, however, since at no place in this E.I.S. has any monetary worth been assigned to existing fish and wildlife resources which will be destroyed, we doubt that this figure represents damage to the existing aquatic resources. Since the existing channel has not been maintained "since about 1941," this figure would not realistically represent annual channel maintenance costs.

Page 83, first paragraph . . . " . . . should result in rapid establishment of the minimal fisheries now present in the modified sections."

It has taken approximately 45 years for the alleged "minimal" fisheries to become reestablished in the previously modified channel. "Rapid" establishment after this proposed remodification is unrealistic.

Paragraph 3 . . . "However, if both sides are denuded, a minimum of 5 years will be needed for growth of adequate cover."

Adequate cover cannot possibly become established in 5 years. It would take 20 to 30 years for the fastest-growing trees to grow large enough to provide any significant shade; and if the channel is maintained so as to accomplish its purpose, adequate shade will never occur, as maintenance procedures would prevent woody vegetative growth on the channel edges. Trees planted on the spoil bank are not close enough to the channel to provide shade.

Page 85 . . . "It is currently impossible to determine the absolute numbers of mobile wildlife that would emigrate or of sedentary wildlife that would perish as the result of channel modification."

Current wildlife investigational techniques permit close estimation of wildlife populations through an evaluation of existing habitat conditions (carrying capacity), which can then be compared with estimates using projected habitat conditions after project completion and land-use changes have accrued. This would give a reasonable estimation of the loss or gain in numbers of wildlife as a result of channel modification. This should be done before the project proceeds further.

Page 86, paragraph 2 . . . This paragraph contradicts the statement on page 60, paragraph 3, that the Longhead Darter, an Endangered Species, was found in Big Muddy Creek in 1961-63. Extensive and intensive sampling should be conducted to determine if this species still exists in the stream, and if found, all efforts be made to preserve its habitat.

Page 86, paragraph 3 . . . Current hunting pressure in the watershed is described as light. The Department of Fish and Wildlife Resources survey of this area indicates that hunting pressure is heavy on all small game species and raccoons.

Mr. John S. Hoffman, Secretary

Page 3

August 25, 1975

Page 92, paragraph 9 An increase in waterfowl feeding and resting habitat is listed as a favorable environmental effect; yet the loss of wood duck nesting and brood habitat, which is far more important in this area, is not listed under adverse environmental effects.

Page 93, paragraph 4 Forage and cover habitat for wildlife species now occurring will be permanently, not temporarily, destroyed. Wildlife forage and cover plantings in the past have not been adequately established or maintained. Kentucky 31 fescue, a very poor wildlife plant, is the only cover normally seen on denuded areas. Also, the removal of hickory and oak vegetation along the stream will result in the elimination of gray and fox squirrel in the areas cleared, and cause population reductions in adjacent areas due to the reduction in food supply.

Page 95, Section 8 "Erosion hazards for component soil types are not presently available in soil manuals of the respective counties."

On page 7 it is stated, "Constructed channels will be through a low-plastic, fine-grained soil (ML and CL according to the Unified Soil Classification system; reference ASTMD 2487)."

Surely, the Soil Conservation Service has some idea of the inherent erosional capabilities of these component soils. Also pertinent would be estimates of the annual sediment load of the Big Muddy Creek before and after the proposed channelization.

Several adverse environmental effects were not considered at all. The greater value of bottomland is mentioned in the watershed description, but the fact that these areas are valuable because of frequent flooding is not mentioned. Reduction of flooding can ultimately result only in a decrease of fertility and therefore of land value. This decrease in fertility can be counteracted only by increasing the use of commercial fertilizers. The supply of fertilizers has become limited in recent years, and their use must be considered a temporary measure and an irretrievable commitment of resources.

No mention is made of the effects of the project on water tables and groundwater recharge. Channelization invariably results in lowering of both, the amount varying with the region. A U.S. Geological Survey report on drainage in the Arkansas Delta region states that "water tables have declined throughout 89% of an area in eastern Arkansas which extends from the Missouri line to Desha County, and underground water levels have receded as much as 10 to 20 feet below former levels." Studies of this type are necessary for western Kentucky, where wells furnish an important domestic water supply, before further drainage is initiated.

An adverse effect which occurs outside the project area, and is therefore usually ignored, is downstream flooding. Quoting from the Linsley study (1949), "The removal of restrictions (channelization) makes for lower stages and faster getaway of the water upstream. This also results in a faster delivery

Mr. John S. Hoffman, Secretary

Page 4

August 25, 1975

of water to downstream points. The reduction in channel storage by shortening the channel and reducing upstream stages can serve only to increase peak rates of flow below the project reach." Quoting from the Lane Study (1947), "Downstream flooding has been caused by channelization of the Sangamon River in Illinois and the Wyconda, Fox, and Salt rivers in Missouri." This increase in flow and velocity also increases downstream silting, which in turn increases pollution because the silt acts as a vehicle for transporting many chemical pesticides and fertilizer elements. These elements are also increased by the need for heavy fertilization to counteract loss of inherent soil fertility due to elimination of upstream flooding.

Another adverse effect not mentioned is the loss of filtering of nutrients during overflow periods, which will no longer occur. This causes eutrophication downstream, as well as decreasing water quality and increasing the cost of water treatment for public consumption and industry.

This impact statement is somewhat confusing in regard to benefit-cost ratios. Presumably, this E.I.S. would address itself only to those land treatment and structural measures that are yet to be installed; however, average annual benefits for structural measures (Appendix A) are evidently computed incorporating all five floodwater retarding structures, four of which are already in operation. Compounding the confusion are statements such as the following (page 98):

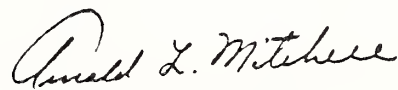
"Without the remaining project, \$228,150 of average annual benefits would not be realized."

This is the same figure that is claimed for all five floodwater retarding structures and channel modifications in Appendix A. This situation could easily be clarified if only those benefits and costs of the remaining structural and land treatment measures were included in this E.I.S. In this same regard, more detailed information is needed in this E.I.S. concerning the derivation of the figures (especially those of benefits) that were included in the benefit-cost ratios.

An area not covered by the cost-benefit formula is the net loss or gain in monetary values from changes in available hunting and fishing opportunity. The value of a hunter-day and fisherman-day have been established by the U.S. Fish and Wildlife Service and the Department of Fish and Wildlife Resources, among others. This net change should be calculated from the aforementioned analysis of changes in numbers of game species through habitat evaluation, and incorporated into the cost-benefit formula.

Thank you for the opportunity to comment.

Sincerely,



Arnold L. Mitchell
Commissioner

ALM:DB/RW:bg

CC: Robert Willis

Peter W. Pfeiffer

Joe Bruna

Bonny D. Laflin

Wm. N. McLemore

Madisonville, Kentucky
September 24, 1975

Mr. Glen E. Murray
State Conservationist
Soil Conservation Service
333 Waller Avenue
Lexington, Kentucky, 40504

Dear Mr. Murray:

The Tradewater River Audubon Society has received a copy of the Draft Environmental Impact Statement on the proposed channelization project on Big Muddy Creek Watershed in Butler and Logan Counties, Kentucky, and we appreciate this opportunity to comment upon the proposal.

After studying the impact statement, it is our strong conviction that the project is unsound, both from an environmental and economic standpoint.

First, we feel that too much emphasis has been placed on the economic value of this project to the area, when actually very little economic benefit would result to the area except possibly to the landowners in the flood planes, whose land would increase in value dramatically, at the expense of all taxpayers. The loss of 963 acres of woodland and 2408 acres of pasture and old fields should be enough to defeat this whole project, and the benefit and cost comparison table seems to contain some overlapping of benefits, making an unrealistic benefit/cost ratio of 1.6 to 1.0.

Also, the amortization figure of 2-5/8 percent is far too low under present inflationary conditions and high interest rates, and this percentage is entirely unrealistic.

Even by the figures contained in the impact statement, there will be a tremendous loss of wildlife and wildlife habitat.

The pollutants which will enter Green River are a major concern to populated areas which must draw water from Green River. This water is already of poor quality, and completion of this project will add a significant amount of pollutants to the River.

In recent years channelization of our streams and rivers has increased so rapidly and with such disastrous results that we cannot view the channelization of a river or stream as one single project, but must weigh the results of all the channelization of all our streams, and take into consideration further plans for channelization. While certain individuals might not view channelization of one stream as catastrophic, the cumulative results of these projects are disastrous, and these results have been well documented.

For these reasons we protest this project, and ask that this protest be included in the final impact statement.

Yours truly,

TRADEWATER RIVER AUDUBON SOCIETY

By *Allen Morgan*

Allen Morgan, President
Route 3, Box 124
Madisonville, Kentucky, 42431

1. The first part of the report is a general introduction to the subject of the study. It discusses the importance of the study and the objectives of the research.

2. The second part of the report is a detailed description of the methodology used in the study. It includes information about the sample size, the data collection methods, and the statistical analysis techniques.

3. The third part of the report is a discussion of the results of the study. It compares the findings with the previous research and discusses the implications of the study.

4. The fourth part of the report is a conclusion and a list of references. The conclusion summarizes the main findings of the study, and the references list the sources used in the research.

5. The fifth part of the report is an appendix containing additional information related to the study, such as raw data, detailed calculations, and supplementary figures.

UNITED STATES DEPARTMENT OF AGRICULTURE
OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20250

OFFICE OF EQUAL OPPORTUNITY

IN REPLY

REFER TO: 8140 - Supplement 7

SUBJECT: Draft Environmental Impact Statement
Big Muddy Creek Watershed, Kentucky

TO: Glen E. Murray
State Conservationist

THROUGH: Verne M. Bathurst
Deputy Administrator for
Management, SCS

The Big Muddy Creek Watershed Environmental Impact Statement (EIS) was reviewed by this office to assess the civil rights impact for the socio-economic effects on minority groups.

In the section of the EIS on Environmental Impact (page 81) there is no specific mention of the effects that the project would have on the minority population living in the affect area (10.2 percent in Logan County and 0.9 percent in Butler County). In accordance with Soil Conservation Service Guidelines for preparing environmental impact statements (see Federal Register, Vol. 39, No. 107, June 3, 1974), it is recommended that in the final draft you include an assessment of the social and economic impacts of impending changes in the watershed on the minority population.

for Percy R. Luning
MILES S. WASHINGTON, JR.
Acting Director



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

1421 PEACHTREE ST., N. E.
ATLANTA, GEORGIA 30309

September 29, 1975

Mr. Glen E. Murray
State Conservationist
U. S. Department of Agriculture
Soil Conservation Service
333 Waller Avenue
Lexington, Kentucky 40503

Dear Mr. Murray:

We have reviewed the Draft Environmental Impact Statement for Big Muddy Creek Watershed in Butler and Logan Counties, Kentucky and indications are that the Statement is well done. However, a more complete account of the adverse effects of channelization should be included.

The Summary Sheet at the beginning of the EIS should include the following:

- j. There will be a decrease in the assimilative capacity of the stream as a result of the channelization, and the pollutational load will be carried farther downstream.
- k. There will be an overall degradation in water quality values, including higher stream temperatures and lower DO values.

And on page 98, add the following additional adverse environmental effect:

- 20. There will be a decrease in the assimilative capacity of the stream with the result that the pollutational load will be carried farther downstream.

In view of the foregoing, we have assigned a rating of L0 -(lack of objection) to the impact of the action and 2(insufficient information) to the Impact Statement.

Please send us five copies of the Final Statement, and if we can be of further assistance, please let us know.

Sincerely,

A handwritten signature in cursive script, appearing to read "David R. Hopkins".

David R. Hopkins
Chief, EIS Branch



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGIONAL OFFICE

1000 North 17th Street
Washington, D.C. 20001

Phone: (202) 368-5000

Mr. J. Edgar Hoover
Director
Federal Bureau of Investigation
Department of Justice
Washington, D.C. 20535

Dear Mr. Hoover:

I am writing to you regarding the recent activities of the [redacted] in the [redacted] area. The [redacted] has been observed in the [redacted] area, and it is believed that they are engaged in [redacted] activities.

The [redacted] has been observed in the [redacted] area, and it is believed that they are engaged in [redacted] activities. The [redacted] has been observed in the [redacted] area, and it is believed that they are engaged in [redacted] activities.

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DEPARTMENT OF THE ARMY
LOUISVILLE DISTRICT, CORPS OF ENGINEERS
P O BOX 59
LOUISVILLE, KENTUCKY 40201

ORLPD-R

9 October 1975

Mr. Glen E. Murray
State Conservationist
Soil Conservation Service
333 Waller Avenue
Lexington, Kentucky 40504

Dear Mr. Murray:

This is in response to the requested review of the Big Muddy Creek Watershed, Kentucky, Draft Environmental Impact Statement.

Basically this office feels the impact statement is adequate and appears to have a well-considered array of alternatives. It was noted, however, that a reference was made on page 18 to Regulation WP-4-1. This regulation has been superseded by 401 KAR 5:025, effective 2 July 1975. It is suggested that this latter regulation be incorporated in the Final Environmental Impact Statement.

We would also like to point out that the project will require a Department of the Army Section 404 Permit if the proposed activity is not completed before 1 July 1976.

The opportunity to respond to this statement is appreciated. If we can be of any further assistance, please contact this office.

Sincerely yours,

A handwritten signature in cursive script, reading "James N. Ellis", is positioned above the typed name.

JAMES N. ELLIS
Colonel, Corps of Engineers
District Engineer



1947

DEPARTMENT OF THE ARMY
LOUISVILLE DISTRICT COMMAND OF ENGINEERS
F. B. 501 25
LOUISVILLE, KY 40203



Chief

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United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER 75/767

Dear Mr. Murry:

Thank you for the letter of August 1, 1975, requesting our views and comments on the draft environmental impact statement for the Big Muddy Creek Watershed, Butler and Logan Counties, Kentucky. Our review indicates that the proposal is adequate as it relates to outdoor recreation, and we are pleased to note that steps have been taken to identify cultural resources. However, several portions of the document should be strengthened with additional information.

General Comments

The draft statement contains no information on groundwater resources or evaluation of impacts of the proposed project on such resources. At least a brief summary of the occurrence of groundwater and aquifer characteristics as well as an indication of the relative significance and magnitude of use of groundwater in the project area should be included. Impacts such as those resulting from changes in streamflow below impoundments or the flooding of areas above structures should be addressed.

The No. 4 Coal Bed (western Kentucky), situated near but above the valley floor in the northern part of the area of channel modification, has been extensively strip mined, however, the project is unlikely to conflict with similar mining of remaining coal. The potential conflict of the channel modification with oil wells located on the valley floor cannot be definitely determined because of the scale of the map in the report.

Although the section on Environmental Impact, page 81, does not discuss minerals, it is believed that they should not be significantly affected by the project. The statement, however, should include some analysis of impacts if the project affects oil production.

The statement recognizes damages to fish and wildlife resources in a general manner but falls short of the full disclosure of these impacts. Although measures are included to reduce losses associated with stream channel alteration as a result of review procedures dictated by Soil Conservation Service Watersheds Memorandum 108, we believe environmental damages remain at a significant level. Accordingly, the Department's Fish and Wildlife Service plans to reevaluate the proposed stream channel works



and effects to fish and wildlife resources and submit a report to the State Conservationist in December 1975, to supercede the official letter report dated April 3, 1962. This forthcoming report will consider stream channel alteration effects to fish and wildlife resources under existing policy and will contain recommendations to satisfactorily reduce fish and wildlife losses.

Specific Comments

Page 6 and 7

The plan of channel modification is divided into three parts with each part being further divided. The description of these plans should be expanded and presented in greater detail. As presented, it is difficult to envision effects to stream ecosystems.

Page 10, Item No. 7

Specifics such as placement, materials, functions, etc., should be included to enable evaluation of "low dams, jetties, etc." in reestablishing pool and riffle habitat.

Page 67, Paragraph 1

This paragraph concerns endangered fishes as listed in the Federal Register (Vol. 39, No. 3, January 4, 1974). This reference should be changed to United States List of Endangered Fauna, May 1974). There should also be a statement noting that the Department of the Interior has advertised a status review of several fishes in the Federal Register, Vol. 40, No. 53, (March 18, 1975), to determine if they should be proposed for listing as endangered or threatened species. These included the Eastern sand darter, Ammocrypta pellucida, and the longhead darter, Percina macrocephala, both of which have been collected in Big Muddy Creek.

Page 75, Paragraph 3, Floodwater Damages

Although flooding is discussed as a problem, the statement fails to recognize overbank flooding as a natural phenomenon which enhances the growth of hardwoods, increases the productivity of many wildlife species such as squirrel, raccoon, opossum, wood duck, woodcock, various song birds, and provides spawning and foraging areas for resident fishes. The statement should discuss the effects of altered flow regimens on fish and wildlife resources.

and offered to furnish the necessary information
which was not given to the Bureau in 1941. The
Bureau was not given a copy of the letter from
the Bureau of the Army, dated 10/10/41, which
was not given to the Bureau in 1941.

Very truly yours,

W. L. R. [Signature]

Enclosure

10/10/41

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Page 85

We agree that it is currently impossible to determine absolute numbers of wildlife that would be affected by elimination of riparian habitat. However, current technology exists for making reasonable estimates, and this should be presented in the final statement.

Page 93, Item No. 4

The statement that forage and cover habitat will be temporarily eliminated is not true. Maintenance of altered stream channels require that berms and channel-side slopes be kept clean. Although total losses will be somewhat reduced by plantings of value to wildlife along a portion of the cleared right-of-way, woody vegetation, as described in the paragraph, will be permanently altered. We suggest that this item be quantified.

Appendix C

The final statement should contain the comments of the State Historic Preservation Officer.

We hope these comments and suggestions will be of assistance to you.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "Stanley R. Berens". The signature is fluid and cursive, with a large initial "S" and "B".

Deputy Assistant

Secretary of the Interior

Mr. Glen E. Murray
State Conservationist
Soil Conservation Service
U.S. Department of Agriculture
333 Waller Avenue
Lexington, Kentucky 40504

Page 1

It is a pleasure to have you here today. We are very
happy to have you with us. We are very happy to have you
with us. We are very happy to have you with us.

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We are very happy to have you here today. We are very
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Page 8

We are very happy to have you here today. We are very
happy to have you with us. We are very happy to have you
with us. We are very happy to have you with us.

Advisory Council
On Historic Preservation
1522 K Street N.W. Suite 430
Washington D.C. 20005

September 20, 1974

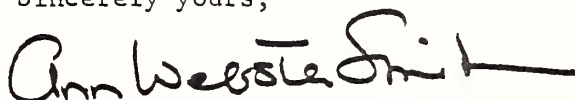
Mr. Glen E. Murray
State Conservationist
Soil Conservation Service
U.S. Department of Agriculture
333 Waller Avenue
Lexington, Kentucky 40504

Dear Mr. Murray:

This is in response to your request of August 29, 1974, for comments on the proposed environmental assessment for the Big Muddy Creek Watershed Project in Butler and Logan Counties, Kentucky.

To insure a comprehensive review of historical, cultural, archeological, and architectural resources, the Advisory Council suggests that the environmental statement contain evidence of contact with the appropriate State Historic Preservation Officer and that a copy of his comments concerning the effects of the undertaking upon these resources be included in the environmental statement. The State Historic Preservation Officer for Kentucky is Mrs. Eldred W. Melton, Director, Kentucky Heritage Commission, 401 Wrapping Street, Frankfort, Kentucky 40601.

Sincerely yours,



Ann Webster Smith
Director, Office of Compliance



Kentucky Heritage Commission
104 Bridge Street
Frankfort, Kentucky 40601

November 9, 1979

Mr. Glen E. Murray
State Conservationist
Soil Conservation Service
333 Waller Avenue
Lexington, Kentucky 40504

Re: An Archaeological Survey and Testing of the Big Muddy Watershed
Project by Betty McGraw

Dear Mr. Murray:

Thank you for transmitting this report to my office for review and comment. Our review indicates that no National Register eligible or listed properties will be affected. The project may proceed.

The author recommends that site 15 Lo 65 be tested if construction endangers the site. I concur with this recommendation.

If I may be of further assistance, please call upon me.

Sincerely yours,

A handwritten signature in cursive script, reading "Eldred W. Melton".

Mrs. Eldred W. Melton
Executive Director and
State Historic Preservation Officer

EWM:lt



DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

MAILING ADDRESS:
U.S. COAST GUARD (G-WS/73)
400 SEVENTH STREET SW.
WASHINGTON, D.C. 20590
PHONE: (202) 426-2262

Mr. Glen E. Murray
State Conservationist
333 Waller Avenue
Lexington, Kentucky 40504

Dear Mr. Murray:

This is in response to your letter of 1 August 1975 addressed to the Commandant, Coast Guard concerning a draft environmental impact statement for the Big Muddy Creek Watershed, Butler and Logan Counties, Kentucky.

The Department of Transportation has reviewed the material submitted. We have no comments to offer nor do we have any objection to this project.

The opportunity to review this draft statement is appreciated.

Sincerely,

D. J. RILEY
Captain, U. S. Coast Guard
Deputy Chief, Office of Marine
Environment and Systems
By direction of the Commandant



DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGION IV

50 7TH STREET N.E.
ATLANTA, GEORGIA 30323

September 17, 1975

OFFICE OF THE
REGIONAL DIRECTOR

HEW 559-8-75

Mr. Glen E, Murray
State Conservationist
U.S. Department of Agriculture
Soil Conservation Service
333 Waller Avenue
Lexington, Kentucky 40504

Subject: Big Muddy Creek Watershed
Butler and Logan Counties, Ky.

Dear Mr. Murray:

We have reviewed the subject draft Environmental Impact Statement. Based upon the data contained in the draft, it is our opinion that the proposed action will have only a minor impact upon the human environment within the scope of this Department's review. The impact statements have been adequately addressed for our comments.

Sincerely yours,

Philip P. Sayre
Regional Environmental Officer
DHEW - Region IV

SAMPLING LOCATIONS



SOURCE: SOIL CONSERVATION SERVICE, 1962

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TABLE 1

WATER QUALITY CHARACTERISTICS AT FOUR LOCATIONS IN THE BIG MUDDY CREEK
DRAINAGE, BUTLER AND LOGAN COUNTIES, KENTUCKY DURING AUGUST, 1974

Parameters ^{a, b}	Sampling Stations			
	1	2	3	4
Alkalinity (as CaCO ₃)				
Carbonate	0	0	0	0
Bicarbonate	71.3	96.7	103	164
Ammonia (as N)	0.24	0.16	0.16	0.12
Biochemical Oxygen Demand	1.7	1.7	1.6	2.2
Chemical Oxygen Demand	17.3	13.1	17.3	11.5
Chloride	4.52	3.90	3.74	6.33
Color - % Transmittance-Filtered (°.45μ)	96%	98%	99%	99%
Color - % Transmittance-Unfiltered	56%	72%	66%	91%
Dissolved Oxygen	3.7	6.2	6.4	5.7
Hardness, Total (as CaCO ₃)	105	108	111	188
Nitrate (as N)	0.26	0.15	0.22	0.29
Nitrite (as N)	<0.01	<0.01	<0.01	0.02
Nitrogen, Total Organic (as N)	1.2	0.89	1.4	0.73
Nitrogen, Soluble Organic (as N)	0.31	0.29	0.29	0.28
Orthophosphate (as P)	0.024	0.024	0.023	0.024
pH	7.4	7.5	7.5	7.4
Phosphorus, Total (as P)	0.104	0.050	0.060	0.062
Specific Conductance (micromhos/cm)	170	215	220	360
Sulfate	21.8	12.3	8.60	19.3
Temperature, Air C°	30	30	28	29
Temperature, Water C°	25	25	25	24
Total Dissolved Solids	112	126	132	224
Total Suspended Solids	76	53	136	17
Turbidity (FTU)	67	33	49	7
Total Coliform (col/100 ml)	70 ^c	1450	550 ^c	70 ^c
Fecal Coliform (col/100 ml)	600 ^c	700	1100 ^c	400 ^c

Sheet 1

TABLE 1 (Continued)

Parameters ^{a,b}	Sampling Stations			
	1	2	3	4
Fecal Streptococci (col/100 ml)	730	560	1300	490
Iron, Total	4.50	2.00	3.50	0.50
Potassium	3.80	2.30	2.10	3.30
Sodium	3.90	2.80	2.50	3.90

^aAll values are expressed in mg/l except where otherwise noted.

^bAnalytic procedures used to determine parameters are listed on following sheets.

^cIt is unusual that fecal coliforms outnumber total coliforms, but this sometimes happens with the membrane filter technique, possibly due to the presence of "false positive" colonies on the fecal coliform media.

TABLE 1 (Continued)

Test	Method	Reference
1. Alkalinity (as CaCO_3)	Methyl-Orange	Std. Methods ^d
2. Ammonia	Distillation - Nesslerization	EPA Methods ^e
3. Biochemical Oxygen Demand	5 Day - BOD	Std. Methods
4. Chemical Oxygen Demand	Chromate Ferrous Ammonium Sulfate	Std. Methods
5. Chloride	Mercuric Nitrate Titration	Std. Methods
6. Color	Colorimetric	FWPCA ^f
7. Hardness, Total (As CaCO_3)	EDTA Titration	Std. Methods
8. Nitrate (as N)	Cadmium Reduction	EPA Methods
9. Nitrite (as N)	Diazotization	EPA Methods
10. Nitrogen, Total Organic (as N)	Digestion - Distillation (Unfiltered)	EPA Methods
11. Nitrogen, Soluble Organic (as N)	Digestion - Distillation (Filtered)	EPA Methods
12. Orthophosphate	Single Reagent	EPA Methods
13. Phosphorous, Total	Single Reagent	EPA Methods
14. Sulfate	BaSO_4 - Gravimetric	Std. Methods
15. Total Dissolved Solids	MFP	EPA Methods
16. Total Suspended Solids	MFP	EPA Methods
17. Turbidity (FTU)	Hach 2100 A Turbidimeter	Std. Methods
18. Total Coliform (col/100 ml)	Membrane Filter Procedure	Std. Methods
19. Fecal Coliform (col/100 ml)	Membrane Filter Procedure	Std. Methods
20. Fecal Streptococci (col/100 ml)	Membrane Filter Procedure	Std. Methods
21. Iron	Atomic Absorption Spectro- photometry	Perkin-Elmer ^g

Sheet 3

TABLE 1 (Continued)

<u>Test</u>	<u>Method</u>	<u>Reference</u>
22. Potassium	Atomic Absorption Spectro- photometry	Perkin-Elmer
23. Sodium	Atomic Absorption Spectro- photometry	Perkin-Elmer

^d APHA, AWWA, WPCF, 1971.

^eEnvironmental Protection Agency, 1971.

^fFederal Water Pollution Control Administration, 1969.

^gPerkin-Elmer, Inc., 1973.

TABLE 2

RESULTS OF SEDIMENT ANALYSIS FOR RESIDUAL PESTICIDES
AT THREE LOCATIONS IN THE BIG MUDDY CREEK DRAINAGE,
BUTLER AND LOGAN COUNTIES, KENTUCKY AUGUST, 1974

Pesticide	Sampling Stations		
	1	2	3
	Parts per Million (w/w) ^a		
Mirex	<0.01	<0.01	<0.01
PCB's	<0.2	<0.04	<0.2
Lindane	<0.01	<0.002	<0.01
Heptachlor	<0.01	<0.002	<0.01
Aldrin	<0.01	<0.002	<0.01
Heptachlor Epoxide	<0.02	<0.004	<0.02
β Chlordane	<0.02	<0.004	<0.02
α Chlordane	<0.02	<0.004	<0.02
p,p-DDE	<0.03	<0.006	<0.03
Dieldrin	<0.03	<0.006	<0.03
Endrin	<0.01	<0.01	<0.01
o,p-DDT	<0.01	<0.01	<0.01
p,p-DDD	<0.01	<0.01	<0.01
p,p-DDT	<0.01	<0.01	<0.01

^a w/w = weight per weight

TABLE 3

LAND USE INVENTORY, BUTLER AND LOGAN COUNTIES

Category	Butler		Logan	
	1958	1967	1958	1967
Total Land Use	283,520	283,520	360,320	360,320
Non-Inventory Acreage				
Federal Non-Cropland ^a	0	0	0	0
Urban and Built-up ^b	4,836	4,884	7,183	9,338
Small Water Areas ^c	1,966	2,029	1,372	850
Total	6,802	6,913	8,555	10,188
Inventory Acreage ^d				
Cropland ^e	64,823	75,024	181,054	149,798
Pasture ^f	34,432	49,765	65,152	80,164
Forests ^g	135,845	135,500	101,014	109,700
Other Land ^h	41,618	16,318	4,095	10,470
Total	276,718	276,607	351,765	350,132

^aFederal Land. Includes military installations, national forests, national wildlife refuges, hospitals, and other federally owned land outside of urban and built-up areas.

^bUrban and Built-up Areas. These lands include cities, villages, other built-up areas of more than 10 acres, industrial sites, railroad yards, cemeteries, airports, golf courses, shooting ranges, institutional and public administrative sites, and similar types of areas. This separation will not necessarily include all land inside city and village limits, and will include some land outside such limits. Non-farm rural residences are accounted for as other land not in farms and are not included in urban.

^cSmall Water Areas. Includes permanent lakes, reservoirs and ponds less than 40 acres in size or streams less than one-eighth of a mile wide.

^dInventory Acreage. Inventory acreage is the acreage after deduction of federal land except cropland operated under lease or permit, urban and built-up areas, and water less than 40 acres in size or streams less than one-eighth of a mile wide from the total land area of the county. This is the acreage for which the County Needs Committee estimated land use.

^eCropland. Land in tillage rotation; orchards and land formerly in such uses as tillage rotation, orchards, vineyards and bush fruit; or open farm land formerly used for crops. Land use is classed according to findings at the time of inspection. Land in winter cover crops following corn, soybeans, etc. is classed on the basis of the preceding crop.

^fPasture and Range. Land in grass or other long-term forage growth that is used primarily for grazing. This does not include rotation pasture or cropland (defined above). Pasture may have been occasionally used for field crops provided the frequency was less than one year in seven or may have been periodically renovated with ryegrass, wheat, oats, etc., for grazing. The land may contain shade trees or scattered timber trees with less than 10 percent canopy, but the principal plant cover is such as to identify its use as permanent grazing land.

TABLE 3 (Continued)

^gForest Land. Lands which are: (1) at least 10 percent stocked by forest trees of any size and capable of producing timber or other wood products, or capable of exerting an influence on the water regime; (2) lands from which the trees described in (1) have been removed to less than 10 percent stocking and which have not been developed for other uses; and (3) afforested (planted) areas. "Soil bank" lands planted to trees are included here. Lands freshly clear-cut and smoothed for cropland or pasture are considered developed for other uses (see 1 above) and were reported under the use anticipated.

^hOther Land. Non-federal rural land not classified as cropland, pasture, forest woodland, or urban and built-up.

Source: State Conservation Needs Inventory Committee Kentucky, 1970.

TABLE 4

PRINCIPAL CROPS HARVESTED, BUTLER AND LOGAN COUNTIES, 1964 AND 1969

<u>Crop</u>	<u>County</u>		
	<u>Butler</u>	<u>1969</u>	<u>Logan</u>
	<u>1964</u>		<u>1964</u>
Hay, excluding sorghum hay			
acres	9,823	9,926	27,544
tons	10,614	17,241	41,802
Field corn, for grain			
acres	8,224	8,123	27,869
bushels	359,835	462,833	1,193,650
Soybeans, for beans			
acres	4,746	6,077	1,871
bushels	97,376	125,260	34,628
Tobacco			
acres	403	460	4,715
pounds	679,165	790,211	8,680,450
Wheat, for grain			
acres	231	402	13,009
bushels	5,207	11,584	445,565
			14,279
			522,087

Source: U.S. Bureau of the Census, 1970.

TABLE 5
 PRINCIPAL TOWNS IN BUTLER AND LOGAN COUNTIES,
 RANKED BY POPULATION

<u>Town</u>	<u>County</u>	<u>Population</u>		<u>Percent Change</u>
		<u>1970</u>	<u>1960</u>	
Russellville	Logan	6,456	5,861	10.2
Morgantown	Butler	1,394	1,318	5.8
Auburn	Logan	1,160	1,013	14.5
Adairville	Logan	973	848	14.7
Lewisburg	Logan	651	512	27.1
Rochester	Butler	252	314	- 19.7
Woodbury	Butler	139	122	13.9

Source: Commonwealth of Kentucky, 1973.

TABLE 6

NUMBER OF COMPANIES IN BUTLER COUNTY, 1967-1972

	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
PRIMARY INDUSTRIES	8	6	4	4	5	3
Agricultural Service, Forestry, Fisheries	0	0	0	0	0	0
Mining	8	6	4	4	5	3
CONTRACT CONSTRUCTION	2	3	6	4	3	5
MANUFACTURING	11	11	9	10	11	10
TRANSPORTATION AND OTHER PUBLIC UTILITIES	4	5	6	6	6	7
TRADE	40	41	42	44	45	44
Wholesale	3	5	5	5	4	4
Retail	37	36	37	39	41	40
FINANCE, INSURANCE AND REAL ESTATE	3	4	4	4	4	5
SERVICES	14	16	18	19	21	17
UNCLASSIFIED ESTABLISHMENTS	3	1	^a	^a	1	2
TOTAL REPORTING	85	87	89	91	96	93

^aNot listed in 1969 or 1970 reports.

Source: U.S. Bureau of the Census, 1967, 1968, 1969, 1970, 1971, and 1972.

TABLE 7

NUMBER OF COMPANIES IN LOGAN COUNTY, 1967-1972

	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
PRIMARY INDUSTRIES	4	6	4	4	5	4
Agricultural Service, Forestry, Fisheries	3	3	2	2	2	2
Mining	1	3	2	2	3	2
CONTRACT CONSTRUCTION	28	30	28	26	31	28
MANUFACTURING	33	35	32	35	35	32
TRANSPORTATION AND OTHER PUBLIC UTILITIES	27	23	23	22	22	22
TRADE	161	155	166	175	173	171
Wholesale	24	21	21	21	19	21
Retail	137	134	145	154	154	150
FINANCE, INSURANCE AND REAL ESTATE	19	20	19	20	19	19
SERVICES	90	88	82	86	93	86
UNCLASSIFIED ESTABLISHMENTS	9	1	4	5	3	2
TOTAL REPORTING	371	358	358	373	381	364

Source: U.S. Bureau of the Census, 1967, 1968, 1969, 1970, 1971, and 1972.

TABLE 8
POPULATION TRENDS - STATE OF KENTUCKY AND SELECTED COUNTIES, 1940-1970

<u>Area</u>	<u>1940</u>	<u>Percent Change 1940-50</u>	<u>1950</u>	<u>Percent Change 1950-60</u>	<u>1960</u>	<u>Percent Change 1960-70</u>	<u>1970</u>
Allen County	15,496	-11.0	13,787	-11.0	12,269	2.7	12,598
Barren County	27,559	3.3	28,461	- 0.6	28,303	1.3	28,677
Butler County	14,371	-21.3	11,309	-18.0	9,586	1.4	9,723
Edmonson County	11,344	-17.3	9,376	-13.8	8,085	8.2	8,751
Hart County	17,239	-11.1	15,321	- 7.8	14,119	- 1.0	13,980
Logan County	23,345	- 4.3	22,335	- 6.4	20,896	4.3	21,793
Metcalfe County	10,853	- 9.2	9,851	-15.1	8,367	- 2.3	8,177
Monroe County	14,070	- 2.1	13,770	-14.3	11,799	- 1.3	11,642
Muhlenberg County	37,554	-13.5	32,501	-14.5	27,791	- 0.9	27,537
Simpson County	11,752	- 0.6	11,678	- 1.1	11,548	13.0	13,054
Todd County	14,234	- 9.4	12,890	-11.8	11,364	- 4.8	10,823
Warren County	36,631	16.7	42,758	6.4	45,491	26.2	57,432
State of Kentucky	2,845,627	3.5	2,944,806	3.2	3,038,156	5.9	3,218,706

Source: U.S. Bureau of the Census, 1971.

TABLE 9POPULATION TRENDS IN INCORPORATED CITIES,
BUTLER AND LOGAN COUNTIES,
1940-1970

<u>County</u> <u>City</u>	<u>1940</u>	<u>Percent</u> <u>Change</u> <u>1940-50</u>	<u>1950</u>	<u>Percent</u> <u>Change</u> <u>1950-60</u>	<u>1960</u>	<u>Percent</u> <u>Change</u> <u>1960-70</u>	<u>1970</u>
BUTLER							
Morgantown	859	-1.0	850	55.1	1,318	5.8	1,394
LOGAN							
Adairville	784	2.0	800	6.0	848	14.7	973
Auburn	955	4.1	994	1.9	1,013	14.5	1,160
Lewisburg	524	-5.3	496	3.2	512	27.1	651
Russellville	3,983	13.7	4,529	29.4	5,861	10.2	6,456

Source: U.S. Bureau of the Census, 1971.

TABLE 10
SEX AND AGE DISTRIBUTION OF POPULATION--BUTLER AND LOGAN COUNTIES, 1940-1970

	1940		1950		1960		1970	
	Butler	Logan	Butler	Logan	Butler	Logan	Butler	Logan
0-9								
Male	1,594 (50.1)	2,240 (52.2)	1,289 (50.8)	2,298 (50.1)	943 (49.8)	2,131 (52.3)	856 (51.7)	1,946 (50.5)
Female	1,588 (49.9)	2,052 (47.8)	1,250 (49.2)	2,287 (49.9)	951 (50.2)	1,941 (47.7)	801 (48.3)	1,904 (49.5)
TOTAL	3,182 (22.2)	4,292 (18.4)	2,539 (22.0)	4,585 (20.5)	1,894 (19.2)	4,072 (19.5)	1,657 (19.5)	3,850 (17.7)
10-19								
Male	1,682 (52.3)	2,361 (51.0)	1,149 (51.9)	1,964 (52.0)	1,024 (51.3)	1,874 (51.0)	955 (51.0)	2,054 (51.9)
Female	1,535 (47.7)	2,266 (49.0)	1,066 (48.1)	1,814 (48.0)	949 (48.1)	1,799 (49.0)	918 (49.0)	1,906 (48.1)
TOTAL	3,217 (22.4)	4,627 (19.8)	2,215 (19.6)	3,778 (16.9)	1,973 (20.5)	3,673 (17.6)	1,873 (19.3)	3,960 (18.2)
20-29								
Male	1,108 (52.0)	1,965 (53.1)	656 (49.8)	1,476 (49.4)	425 (49.3)	1,128 (49.8)	702 (57.5)	1,280 (46.0)
Female	1,023 (48.0)	1,738 (46.9)	662 (50.2)	1,510 (50.6)	437 (50.7)	1,137 (50.2)	518 (42.5)	1,503 (54.0)
TOTAL	2,131 (14.8)	3,703 (15.9)	1,318 (11.8)	2,986 (13.7)	862 (9.3)	2,265 (10.8)	1,220 (12.5)	2,783 (12.8)
30-49								
Male	1,585 (50.7)	2,808 (50.2)	1,317 (50.9)	2,807 (50.1)	1,033 (49.1)	2,367 (48.1)	961 (48.9)	2,262 (48.2)
Female	1,540 (49.3)	2,785 (49.8)	1,269 (49.1)	2,799 (49.9)	1,079 (50.3)	2,550 (51.9)	1,004 (51.1)	2,430 (51.8)
TOTAL	3,125 (21.7)	5,593 (24.0)	2,586 (22.9)	5,606 (25.1)	2,103 (21.9)	4,917 (23.5)	1,965 (20.2)	4,692 (21.5)
50-64								
Male	900 (53.1)	1,537 (50.7)	783 (51.4)	1,586 (50.4)	760 (50.3)	1,684 (50.7)	818 (49.7)	1,767 (48.7)
Female	796 (46.9)	1,496 (49.3)	741 (48.6)	1,563 (49.6)	760 (50.3)	1,640 (49.3)	828 (50.3)	1,861 (51.3)
TOTAL	1,696 (11.8)	3,033 (13.0)	1,524 (13.6)	3,149 (14.8)	1,520 (15.3)	3,324 (15.9)	1,646 (16.9)	3,628 (16.6)
65 and Over								
Male	524 (51.4)	1,089 (51.9)	608 (53.9)	1,088 (48.8)	637 (51.6)	1,244 (47.0)	667 (49.0)	1,331 (46.2)
Female	496 (48.6)	1,008 (48.1)	519 (46.1)	1,143 (51.2)	597 (48.4)	1,401 (53.0)	695 (51.0)	1,549 (53.8)
TOTAL	1,020 (7.1)	2,097 (9.1)	1,127 (10.0)	2,231 (10.0)	1,234 (12.9)	2,645 (12.7)	1,362 (14.1)	2,880 (13.2)
TOTAL POPULATION	14,371	23,345	11,309	22,335	9,586	20,896	9,723	21,793
Male	7,393 (51.4)	11,900 (51.0)	5,808 (51.4)	11,229 (50.3)	4,820 (50.3)	10,428 (49.9)	4,859 (50.0)	10,640 (48.7)
Female	6,978 (48.6)	11,445 (49.0)	5,501 (48.6)	11,106 (49.7)	4,766 (49.7)	10,468 (50.1)	4,864 (50.0)	11,153 (51.2)

Source: U.S. Bureau of the Census, 1971.

TABLE 11

BLACK POPULATION, BUTLER AND LOGAN COUNTIES, 1950-1970

<u>County</u>	<u>1950</u>	<u>% Change 1950-1960</u>	<u>1960</u>	<u>% Change 1960-1970</u>	<u>1970</u>	<u>% Change 1950-1970</u>
Butler	149	-51.7	72	-29.2	51 ^a	-65.8
Logan	2,545	-9.0	2,316	-5.8	2,182 ^b	-14.3

^a37 persons (72.6 percent) aged 60 or over

^b417 persons (19.1 percent) aged 60 or over

Source: Barren River Area Development District, 1974.

TABLE 12

POPULATION DENSITY, BUTLER AND LOGAN COUNTIES, 1940-1970

<u>County</u>	<u>Land Area (sq mi)</u>	<u>Population per Square Mile</u>			
		<u>1940</u>	<u>1950</u>	<u>1960</u>	<u>1970</u>
Butler	443	32.4	25.5	21.6	21.9
Logan	563	41.5	39.6	37.1	38.7

Source: U.S. Bureau of the Census, 1971.

TABLE 13

HOUSEHOLD DENSITY, BUTLER AND LOGAN COUNTIES, 1950-1970

<u>County</u>	<u>Median Persons Per Housing Unit</u>		
	<u>1950</u>	<u>1960</u>	<u>1970</u>
Butler	3.4	3.5	2.7
Logan	3.2	3.3	2.6
Kentucky	3.2	3.5	2.7

Source: Commonwealth of Kentucky, 1973.

TABLE 14

PLACE OF RESIDENCE, BUTLER AND LOGAN COUNTIES, 1930-1970

	<u>1930</u>	<u>1940</u>	<u>1950</u>	<u>1960</u>	<u>1970</u>
Butler County					
Urban (%)	0	0	0	0	0
Rural (%)	100.0	100.0	100.0	100.0	100.0
Farm (%)	NA	76.1	71.5	48.3	32.4
Non-Farm (%)	NA	23.9	28.5	51.7	67.6
Logan County					
Urban (%)	15.1	17.1	20.3	31.1	29.6
Rural (%)	84.9	82.9	79.7	68.9	70.4
Farm (%)	NA	81.5	57.0 ^a	63.1 ^a	31.6 ^a
Non-Farm (%)	NA	18.5	22.7	36.9	38.8

^aBeginning with the 1950 census, there was a change in classification for certain special groups of people (e.g. persons in institutions, tourist camps, summer camps, and motels were classified as farm residents in the 1930 and 1940 censuses); 1950, 1960, 1970 farm populations would be about 9 percent larger if the 1930-40 classifications were used.

Source: U.S. Bureau of the Census, 1971.

TABLE 15

POPULATION PROJECTIONS, BUTLER AND LOGAN COUNTIES, 1975-2020

<u>Year</u>	<u>County</u>	
	<u>Butler</u>	<u>Logan</u>
1970 ^a	9,723	21,793
1975	10,107	22,929
1980	10,590	24,467
1990	11,744	28,394
2000	13,218	33,259
2010	14,911	39,002
2020	16,883	45,689

^aActual 1970 Census count.

Source: Kentucky Program Development Office, 1972.

TABLE 16

LABOR FORCE, BUTLER AND LOGAN COUNTIES, 1960 AND 1970

	<u>Total</u>	<u>Labor Force</u>		<u>Participation Rate</u> ^a	
		<u>Male</u>	<u>Female</u>	<u>Male</u>	<u>Female</u>
BUTLER					
1960	2,874	2,299	575	66.9	16.9
1970	3,172	2,078	1,094	60.6	31.5
LOGAN					
1960	7,572	5,566	2,006	74.9	25.9
1970	8,387	5,371	3,016	73.3	37.9

^aPercent of those 14 years of age and over who are in the labor force.

Source: Commonwealth of Kentucky, 1973.

TABLE 17

EMPLOYMENT BY INDUSTRY, 1970

	<u>Butler</u>		<u>Logan</u>		<u>State of Ky.</u>	
	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>	<u>No.</u>	<u>%</u>
Agriculture, Forestry & Fisheries	416	14.1	1,405	17.2	73,607	6.8
Mining	105	3.6	33	0.4	27,762	2.5
Construction	298	10.1	404	5.0	76,739	7.0
Manufacturing	1,042	35.3	2,921	35.8	278,827	25.6
Transportation & Communication	129	4.4	160	2.0	54,886	5.0
Trade	335	11.4	1,133	13.9	203,310	18.7
Public Administration	94	3.2	281	3.4	51,152	4.7
Other	529	17.9	1,811	22.2	322,475	29.6
Total	2,948	100.0	8,148	100.0	1,088,758	100.0

Source: Commonwealth of Kentucky, 1973.

TABLE 18

UNEMPLOYMENT TRENDS, 1965 TO 1972

<u>County</u>	<u>1965</u>	<u>1966</u>	<u>Rate of Estimated Unemployment</u>					
			<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
Butler	10.4	10.5	11.4	7.6	7.0	9.7	10.3	8.9
Logan	3.1	3.3	2.9	2.4	2.0	2.6	6.8	2.9
State of Kentucky	5.9	5.2	5.1	4.6	4.2	4.8	5.3	3.6

Source: Commonwealth of Kentucky, 1973.

TABLE 19

PLACE OF WORK DURING CENSUS WEEK, 1970, BUTLER AND LOGAN COUNTIES

<u>County</u>	<u>Place Worked During Census Week^a</u>		<u>Total</u>
	<u>Same County (%)</u>	<u>Other County (%)</u>	
Butler	1,871 (69.9)	806 (30.1)	2,677
Logan	6,216 (91.8)	559 (8.2)	6,775

^aIncludes only workers reporting specific place of work.

Source: Commonwealth of Kentucky, 1973.

TABLE 20
SELECTED INCOME CHARACTERISTICS, STATE OF KENTUCKY, BUTLER, LOGAN AND ADJACENT COUNTIES, 1970

Income Characteristics	State of Kentucky	Butler County	Logan County	Allen County	Edmonson County	Grayson County	Muhlenberg County	Ohio County	Simpson County	Todd County	Warren County
TOTAL FAMILIES	825,222	2,701	6,040	3,703	2,412	4,483	7,545	5,129	3,550	2,891	14,111
Family Income (%)											
Less than \$3,000	18.5	33.0	24.1	31.6	27.3	29.7	23.4	25.5	21.3	24.3	18.1
\$3,000-\$4,999	14.0	18.8	15.3	19.0	21.8	16.8	14.7	16.6	14.6	20.0	13.7
\$5,000-\$6,999	14.3	16.9	16.2	18.4	14.9	16.1	13.7	12.8	17.0	19.4	15.5
\$7,000-\$9,999	20.7	17.4	20.8	17.4	21.8	19.4	19.4	21.5	20.3	16.9	19.4
\$10,000-\$14,999	20.9	12.6	15.5	9.8	10.9	12.7	21.2	17.4	18.8	12.3	21.7
\$15,000-\$24,999	9.2	1.3	5.7	3.6	2.5	4.2	6.6	5.3	6.5	5.3	8.9
\$25,000 or more	2.4	-	2.4	0.2	0.8	1.1	1.0	0.9	1.5	1.8	2.7
Median Family Income											
All Families	\$ 7,439	\$ 4,772	\$ 6,252	\$ 4,929	\$ 5,101	\$ 5,401	\$ 6,719	\$ 6,142	\$ 6,666	\$ 5,546	\$ 7,398
White	7,602	4,772	6,613	4,907	5,146	5,408	6,897	6,195	6,830	5,838	7,657
Black	5,128	b	3,130	b	b	b	4,000	b	5,525	3,278	4,752
Families Below Low-Income Level	19.3%	30.5%	22.8%	30.1%	28.2%	28.6%	22.3%	24.7%	19.9%	25.7%	17.9%
Families Below 125 Percent of Low-Income Level	25.5%	43.0%	31.5%	37.2%	38.5%	36.9%	29.5%	31.5%	26.6%	32.0%	24.5%

^aLow-income threshold (\$3,388) was computed on a national basis.

^bData not shown where population was less than 400.

Source: U.S. Bureau of the Census, 1971.

TABLE 21

VALUE OF AGRICULTURAL PRODUCTION BY PRODUCT
IN BUTLER AND LOGAN COUNTIES, 1969

<u>Product</u>	<u>Butler County</u>	<u>Logan County</u>
Crops sold (including nursery products and hay)	\$ 1,019,160	\$ 5,681,256
Grains	522,245	2,219,758
Tobacco	352,303	2,872,044
Cotton and cottonseed	---	---
Fieldseeds, hay, forage and silage	132,104	539,464
Other field crops	2,661	32,039
Vegetables, sweetcorn and melons	3,678	7,858
Fruits, nuts and berries	6,169	9,193
Nursery and greenhouse products	---	900
Forest products sold	62,585	57,789
Livestock, poultry and their products sold	1,948,992	8,206,687
Poultry and poultry products	14,125	15,663
Dairy products	300,472	2,814,320
Dairy cattle and calves	70,458	553,258
Other cattle and calves	766,453	2,887,280
Hogs, sheep and goats	790,198	1,920,919
Other livestock and livestock products	7,298	15,247
Farms with farm-related income from:		
Customwork and other agriculture services	45,692	126,782
Recreational services	170	7,490
Government farm programs	232,924	753,448

Source: U.S. Bureau of the Census, 1969.

TABLE 22DISTRIBUTION OF TOTAL FARM ACREAGE,
BUTLER AND LOGAN COUNTIES, 1969

<u>Farmland Use (in acres)</u>	<u>Butler County</u>	<u>Logan County</u>
Total Cropland	90,583	205,644
Harvested	26,121	88,521
Cropland used only for pasture or grazing	39,044	77,743
All other cropland	25,418	39,380
Woodland (including woodland pasture)	55,854	60,554
All Other Land	28,141	37,905

Source: U.S. Bureau of the Census, 1969.

TABLE 23

FARM ACREAGE AND VALUE, BUTLER AND LOGAN COUNTIES, 1959-1969.

	<u>Number of Farms</u>	<u>Total Farm Acreage</u>	<u>Average Acreage of Farm</u>	<u>Average Value of Farm^a</u>	<u>Average Value Per Acre</u>
<u>Butler County</u>					
1959	1,119	283,520	144.3		
1964	913	283,525	165.3	\$ 12,540	\$ 75.01
1969	1,007	283,392	173.3	22,129	127.64
<u>Logan County</u>					
1959	2,308	360,320	135.4		
1964	2,123	360,325	140.9	\$ 24,054	\$ 170.42
1969	1,957	360,128	155.3	31,845	204.93

^aLand and Buildings

Source: U.S. Bureau of the Census, 1959, 1964, 1969.

TABLE 24
SUMMARY OF FAMILY STRUCTURE DATA

<u>Family Size</u>		
<u>Number in Family</u>	<u>Percentage of Respondents</u>	
1	3.3	
2	33.3	
3	20.0	
4	30.0	
5	6.7	
6	6.7	
7 or more	0.0	

<u>School-Age Children</u>		
<u>Number of Children</u>	<u>Respondents</u>	<u>Percentage</u>
0	18	60.0
1	10	33.0
2	1	3.3
3	1	3.3
4 or more	0	0.0

Source: Dames & Moore, 1974.

TABLE 25

YEARS OF SCHOOL COMPLETED BY ADULT POPULATION,
BUTLER AND LOGAN COUNTIES, BRADD, AND STATE OF KENTUCKY

<u>School Years Completed</u>	<u>Butler County</u>	<u>Logan County</u>	<u>Bradd</u>	<u>State of Kentucky</u>
Less than 8	2,081 (37.3%)	3,447 (27.2%)	31,627 (30.9%)	404,231 (23.6%)
Less than 12	4,452 (79.7%)	8,639 (68.3%)	70,064 (68.4%)	1,053,196 (61.5%)
12 Years	809 (14.5%)	2,748 (21.7%)	19,882 (19.4%)	412,640 (24.1%)
Over 12	323 (5.8%)	1,266 (10.0%)	12,528 (12.2%)	247,462 (14.4%)

Source: Commonwealth of Kentucky, 1973.

TABLE 26

PERCENT OF BUTLER AND LOGAN COUNTY POPULATION BELOW POVERTY LEVEL, 1969,
BY SELECTED POPULATION SUBGROUPS

<u>Subgroup</u>	<u>Butler County</u>	<u>Logan County</u>	<u>BRADD</u>	<u>State of Kentucky</u>
Total Families	2,701	6,040	49,512	825,222
Families Below Poverty Level	820 (30.3%)	1,366 (22.6%)	12,396 (24.8%)	158,442 (19.2%)
Black Families Below Poverty Level	a	(55.4%)	(41.2%)	(33.5%)
Persons Over 65	(58.6%)	(45.5%)	(49.6%)	(39.9%)

^aDenotes a Black population under 400.

Source: Barren River Area Development District, 1974.

TABLE 27PUBLIC ASSISTANCE PAYMENTS, BUTLER AND LOGAN COUNTIES,
FISCAL YEAR 1972-73

<u>Recipient</u>	<u>Butler County</u>	<u>Logan County</u>	<u>BRADD</u>
Aged			
Money Payment	435	637	4,874
Medical Only	163	146	1,342
Blind			
Money Payment	11	8	86
Medical Only	0	2	12
Disabled			
Money Payment	113	170	1,230
Medical Only	24	27	197
AFDC ^a			
Money Payment			
Families	83	280	1,830
Adults	99	264	1,828
Children	203	709	4,647
Medical Only			
Families	63	70	544
Adults	85	54	527
Children	172	155	1,245

^a Aid to Families with Dependent Children.

Source: Barren River Area Development District, 1974.

TABLE 28

HEALTH CARE FACILITIES AND MANPOWER,
BUTLER AND LOGAN COUNTIES, 1972

<u>Health Care Category</u>	<u>Butler County</u>	<u>Logan County</u>	<u>BRADD</u>	<u>State of Kentucky</u>
Hospital Beds				
Number	0	120	743	13,417
Number per 1000	0	5.5	3.9	4.2
Intensive Care Beds				
Number	0	0	8	424
Number per 1000	0	0	0.1	0.1
Nursing Home Beds				
Number	66	30	469	7700
Number per 1000	6.8	1.4	2.5	2.4
Number per 1000 elderly ^a	48.5	10.4	21.3	22.8
Physicians				
General and Family	2	8	62	1029
Surgeons	0	3	17	498
Pediatricians	0	0	6	201
Other	0	0	33	1550
Total	2	11	118	3278
Registered Nurses	7	33	297	7850
Dentists	2	5	66	1004

^aOver 65 years old.

Source: Commonwealth of Kentucky, 1973.

TABLE 29

RELATIVE FREQUENCIES, DENSITIES, DOMINANCE, AND
IMPORTANCE VALUES OF TREE SPECIES (1.0 INCH OR
GREATER DBH) GROWING IN SAMPLING AREA 1^a

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>	<u>Importance Value ($\sum RF+RD+RD$)</u>
Pignut Hickory	25.0	22.5	21.5	68.7
American Sycamore	9.4	12.5	28.1	50.0
Shagbark Hickory	9.4	12.5	20.1	42.0
Tuliptree	6.3	5.0	18.7	30.0
Boxelder	12.5	12.5	2.0	27.0
Sugarberry	9.4	12.5	5.9	27.8
Slippery Elm	6.3	5.0	3.2	14.5
Winged Elm	6.3	5.0	0.3	11.6
White Ash	6.3	5.0	0.2	11.5
Post Oak	3.1	2.5	0.1	5.7
Blue Beech	3.1	2.5	0.1	5.7
Red Mulberry	3.1	2.5	0.1	5.7
Totals	100.2	100.0	100.0	300.2

^aNumber of trees per acre = 230.0.

Basal area of the trees per acre = 150 square feet per acre.

TABLE 30

RELATIVE FREQUENCIES, DENSITIES, AND IMPORTANCE
VALUES OF UNDERSTORY TREE OR SHRUB SPECIES (LESS
THAN 1.0 INCH DBH)
GROWING IN SAMPLING AREA 1^a

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Importance Value ($\Sigma RF+RD$)</u>
Boxelder	37.5	37.5	75.0
Pignut Hickory	16.7	25.0	41.7
Cane	12.5	10.0	22.5
Sugarberry	8.3	10.0	18.3
White Ash	8.3	7.5	15.8
Pin Oak	4.2	2.5	6.7
Black Oak	4.2	2.5	6.7
Winged Elm	4.2	2.5	6.7
Blue Beech	4.2	2.5	6.7
Totals	100.1	100.0	200.1

^aUnderstory trees per acre = 514.9.

TABLE 31

RELATIVE FREQUENCIES, DENSITIES, DOMINANCE, AND
IMPORTANCE VALUES OF TREE SPECIES (1.0 INCH OR
GREATER DBH)

GROWING IN SAMPLING AREA 2^a

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>	<u>Importance Value ($\Sigma RF+RD+RD$)</u>
Pin Oak	36.4	47.5	63.2	147.1
Red Maple	13.6	12.5	21.5	47.6
Blue Beech	22.7	22.5	2.1	47.3
Catalpa	9.1	7.5	8.7	25.3
Sugarberry	13.6	7.5	3.0	24.1
Pignut Hickory	4.5	2.5	1.5	8.5
Totals	99.9	100.0	100.0	299.9

^aTrees per acre = 175.0.

Basal area of the trees per acre = 105 square feet/acre.

TABLE 32

RELATIVE FREQUENCIES, DENSITIES, AND IMPORTANCE VALUES OF
UNDERSTORY TREE OR SHRUB SPECIES (LESS THAN 1.0 INCH DBH)
GROWING IN SAMPLING AREA 2^a

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Importance Value ($\Sigma RF + RD$)</u>
Pin Oak	22.2	27.5	49.7
Red Maple	25.9	20.0	45.9
Sugarberry	18.5	17.5	36.0
Pignut Hickory	14.8	15.0	29.8
Blue Beech	11.1	15.0	26.1
Buttonbush	3.7	2.5	6.2
Post Oak	3.7	2.5	6.2
Totals	99.9	100.0	199.9

^aUnderstory trees per acre = 435.6.

TABLE 33

RELATIVE FREQUENCIES, DENSITIES, DOMINANCE, AND
IMPORTANCE VALUE OF TREE SPECIES (1.0 INCH OR
GREATER DBH)

GROWING IN SAMPLING AREA 3^a

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>	<u>Importance Value ($\Sigma RF+RD+DD$)</u>
Sweet Gum	14.7	17.5	18.8	51.0
Black Oak	11.7	12.5	10.7	34.9
White Ash	8.8	7.5	6.7	23.0
Shagbark Hickory	2.9	2.5	15.5	20.9
Pin Oak	2.9	2.5	15.5	20.9
Tulip Tree	5.8	7.5	4.8	18.1
Honey Locust	5.8	5.0	6.1	16.9
American Sycamore	5.8	5.0	5.6	16.4
Red Juniper	5.8	5.0	5.4	16.2
Slippery Elm	2.9	7.5	3.7	14.1
Northern Red Oak	5.8	5.0	3.2	14.0
Pignut Hickory	5.8	5.0	2.1	12.9
Sugarberry	5.8	5.0	.3	11.1
Red Maple	5.8	5.0	.2	11.0
Boxelder	2.9	2.5	.4	5.8
Blue Beech	2.9	2.5	.2	5.6
Red Mulberry	2.9	2.5	.0	5.4
Totals	99.0	100.0	99.2	298.2

^aTrees per acre = 391.

Basal area of the trees per acre = 117 square feet per acre.

TABLE 34

RELATIVE FREQUENCIES, DENSITIES, AND IMPORTANCE
VALUES OF UNDERSTORY TREE OR SHRUB SPECIES (LESS
THAN 1.0 INCH DBH)
GROWING IN SAMPLING AREA 3^a

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Importance Value ($\Sigma RF+RD$)</u>
Sugarberry	16.7	17.5	34.2
Sweet Gum	13.9	12.5	26.4
Black Oak	11.1	10.0	21.1
Blue Beech	8.3	7.5	15.8
Pignut Hickory	8.3	7.5	15.8
Red Maple	5.6	10.0	15.6
White Ash	5.6	5.0	10.6
White Mulberry	5.6	5.0	10.6
Boxelder	5.6	5.0	10.6
Tulip Tree	5.6	5.0	10.6
Shagbark Hickory	2.8	5.0	7.8
Post Oak	2.8	2.5	5.3
Catalpa	2.8	2.5	5.3
Sassafras	2.8	2.5	5.3
American Sycamore	2.8	2.5	5.3
Totals	100.3	100.0	200.3

^aUnderstory trees per acre = 1437.6.

TABLE 35

RELATIVE FREQUENCIES, DENSITIES, DOMINANCE, AND
IMPORTANCE VALUES OF TREE SPECIES (1.0 INCH OR
GREATER DBH)

GROWING IN SAMPLING AREA 4^a

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>	<u>Importance Value ($\Sigma RD+RD+RD$)</u>
Northern Red Oak	16.1	15.0	29.6	60.7
Blue Beech	22.6	25.0	0.4	48.0
Sugar Maple	19.4	22.5	4.9	46.8
Shagbark Hickory	9.7	7.5	23.3	40.5
Pignut Hickory	6.5	5.0	16.0	27.5
American Sycamore	3.2	2.5	20.0	25.7
Red Cedar	9.7	7.5	0.3	17.5
Sugarberry	6.5	5.0	4.5	16.0
Red Maple	3.2	7.5	0.6	11.3
Black Walnut	3.2	2.5	0.1	5.8
Totals	100.1	100.0	99.7	299.8

^aTrees per acre = 195.

Basal area of the trees per acre = 192 square feet per acre.

TABLE 36

RELATIVE FREQUENCIES, DENSITIES, AND IMPORTANCE
VALUES OF UNDERSTORY TREE OR SHRUB SPECIES (LESS
THAN 1.0 INCH DBH)
GROWING IN SAMPLING AREA 4^a

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Importance Value (ΣRF+RD)</u>
Blue Beech	26.1	30.0	56.1
Sugar Maple	21.7	25.0	46.7
Red Maple	13.0	17.5	30.5
Sugarberry	8.7	7.5	16.2
Northern Red Oak	8.7	5.0	13.7
White Ash	8.7	5.0	13.7
Shagbark Hickory	4.4	5.0	9.4
Slippery Elm	4.4	2.5	6.9
Black Cherry	4.4	2.5	6.9
Totals	100.1	100.0	200.1

^aUnderstory trees per acre = 2354.6.

TABLE 37

RELATIVE FREQUENCIES, DENSITIES, DOMINANCE, AND
IMPORTANCE VALUES OF TREE SPECIES (1.0 INCH OR
GREATER DBH)
GROWING IN SAMPLING AREA 5^a

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Relative Dominance</u>	<u>Importance Value ($\Sigma RF+RD+DD$)</u>
American Sycamore	23.3	27.5	71.7	122.5
Sugarberry	20.0	17.5	9.2	46.7
Boxelder	16.7	15.0	1.8	33.5
Black Cherry	6.7	5.0	9.6	21.3
White Ash	6.7	10.0	3.0	19.7
Pignut Hickory	10.0	7.5	0.4	17.9
Honey Locust	3.3	7.5	1.4	12.2
Slippery Elm	6.7	5.0	0.2	11.9
Northern Red Oak	3.3	2.5	2.4	8.2
Black Walnut	3.3	2.5	0.3	6.1
Totals	100.0	100.0	100.0	300.0

^aTrees per acre = 400.

Basal area of the trees per acre = 160 square feet per acre.

TABLE 38

RELATIVE FREQUENCIES, DENSITIES, AND IMPORTANCE
VALUES OF UNDERSTORY TREE OR SHRUB SPECIES (LESS
THAN 1.0 INCH DBH)
GROWING IN SAMPLING AREA 5^a

<u>Species</u>	<u>Relative Frequency</u>	<u>Relative Density</u>	<u>Importance Value ($\Sigma RF + RD$)</u>
Spice Bush	25.9	30.0	55.9
Boxelder	22.2	17.5	39.7
White Ash	11.1	15.0	26.1
Cane	11.1	7.5	18.6
Sugarberry	7.4	7.5	14.9
Common Elder	3.7	7.5	11.2
Sugar Maple	3.7	5.0	8.7
Pignut Hickory	3.7	2.5	6.2
American Sycamore	3.7	2.5	6.2
Black Walnut	3.7	2.5	6.2
Redbud	3.7	2.5	6.2
Totals	99.9	100.0	199.9

^aUnderstory trees per acre = 2354.6

TABLE 39

SUMMARY OF FLORA IDENTIFIED IN THE ENVIRONS
OF THE BIG MUDDY CREEK WATERSHED^a

Family	Scientific Name Common Name	Sampling Areas ^b				
		1	2	3	4	5
Cupressaceae						
	<u>Juniperus virginiana</u> L. Red Cedar	-	-	a	a	-
Gramineae						
	<u>Arundinaria gigantea</u> (Walt.) Chapm. Cane	b	-	-	-	b
Juglandaceae						
	<u>Juglans nigra</u> L. Black Walnut	-	-	-	a	a, b
	<u>Carya ovata</u> (Mill.) K. Koch Shagbark Hickory	a	-	a, b	a, b	-
	<u>Carya ovalis</u> (Wang.) Sarg. Pignut Hickory	a, b	a, b	a, b	a	a, b
Betulaceae						
	<u>Carpinus caroliniana</u> Walt. Blue Beech	a, b	a, b	a, b	a, b	-
Fagaceae						
	<u>Quercus stellata</u> Wang. Post Oak	a	b	b	-	-
	<u>Quercus velutina</u> Lam. Black Oak	b	-	a, b	-	-
	<u>Quercus rubra</u> Northern Red Oak	-	-	a	a, b	a
	<u>Quercus palustris</u> Muenchh. Pin Oak	b	a, b	a	-	-
Ulmaceae						
	<u>Ulmus rubra</u> Slippery Elm	a	-	a	b	a
	<u>Ulmus alata</u> Michx. Winged Elm	a, b	-	-	-	-
	<u>Celtis laevigata</u> Willd. Sugarberry	a, b	a, b	a, b	a, b	a, b
Moraceae						
	<u>Morus rubra</u> L. Red Mulberry	a	-	a	-	-
	<u>Morus alba</u> L. White Mulberry	-	-	b	-	-

TABLE 39 (Continued)

Family	Scientific Name	Sampling Areas ^b				
	Common Name	1	2	3	4	5
Magnoliaceae						
	<u>Liriodendron tulipifera</u> L.					
	Tuliptree	a	-	a,b	-	-
Lauraceae						
	<u>Sassafras albidum</u> (Nutt.) Nees					
	Sassafras	-	-	b	-	-
	<u>Lindera benzoin</u> (L.) Blume.					
	Spice Bush	-	-	-	-	b
Hamamelidaceae						
	<u>Liquidambar styraciflua</u> L.					
	Sweet Gum	-	-	a,b	-	-
Platanaceae						
	<u>Platanus occidentalis</u> L.					
	American Sycamore	a	-	a,b	a	a,b
Rosaceae						
	<u>Prunus serotina</u> Ehrh.					
	Black Cherry	-	-	-	b	a
Caesalpiniaceae						
	<u>Cercis canadensis</u> L.					
	Redbud	-	-	-	-	b
	<u>Gleditsia triacanthos</u>					
	Honey Locust	-	-	a	-	a
Aceraceae						
	<u>Acer saccharum</u> Marsh.					
	Sugar Maple	-	-	-	a,b	b
	<u>Acer rubrum</u> L.					
	Red Maple	-	a,b	a,b	a,b	-
	<u>Acer negundo</u> L.					
	Boxelder	a,b	-	a,b	-	a,b
Oleaceae						
	<u>Fraxinus americana</u> L.					
	White Ash	a,b	-	a,b	b	a,b
Bignoniaceae						
	<u>Catalpa speciosa</u> Warder.					
	Catalpa	-	a	b	-	-

TABLE 39 (Continued)

Family	Scientific Name Common Name	Sampling Areas ^b				
		1	2	3	4	5
Rubiaceae						
	<u>Cephalanthus occidentalis</u> L.					
	Buttonbush	-	b	-	-	-
Caprifoliaceae						
	<u>Sambucus canadensis</u> L.					
	Common Elder	-	-	-	-	b

^aTaxonomy and phylogeny based on H. A. Gleason, 1968.

^bNotation given: a = species observed in overstory cover; b = species observed in understory cover; - = species absent in sampling area.

TABLE 40

BIRDS WHOSE RANGE INCLUDES BIG MUDDY CREEK WATERSHED
IN BUTLER AND LOGAN COUNTIES, KENTUCKY

Family Name	Scientific Name	Common Name	1	2	3	4
Gaviidae						
	<u>Gavia immer</u>	Common Loon	W-r	-	-	x
Podicipedidae						
	<u>Podiceps auritus</u>	Horned Grebe	W-r	-	-	x
	<u>Podilymbus podiceps</u>	Pied-billed Grebe	P-uc	x	1	x
Phalacrocoracidae						
	<u>Phalacrocorax auritus</u>	Double-crested Cormorant	P-c	x	-	x
Ardeidae						
	<u>Ardea herodias</u>	Great Blue Heron	P-c	x	-	x
	<u>Butorides virescens</u>	Green Heron*	S-c	x	-	x
	<u>Florida caerulea</u>	Little Blue Heron	S-r	-	-	x
	<u>Bubulcus ibis</u>	Cattle Egret	S-r	-	-	x
	<u>Casmerodius albus</u>	Common Egret	S-c	x	-	x
	<u>Egretta thula</u>	Snowy Egret	M-uc	-	-	x
	<u>Nycticorax nycticorax</u>	Black-crowned Night Heron	S-fc	x	-	x
	<u>Nyctanassa violacea</u>	Yellow-crowned Night Heron	S-fc	-	-	x
	<u>Ixobrychus exilis</u>	Least Bittern	S-uc	-	-	-
	<u>Botaurus lentiginosus</u>	American Bittern	M-fc	x	-	-
Ciconiidae						
	<u>Mycteria americana</u>	Wood Stork	S-r	-	-	-
Anatidae						
	<u>Branta canadensis</u>	Canada Goose	W-r	x	-	-
	<u>Chen caerulescens</u>	Snow Goose	M-fc	-	-	-
	<u>Anas platyrhynchos</u>	Mallard	W-c	x	37	-
	<u>Anas rubripes</u>	Black Duck	W-c	-	3	-
	<u>Anas strepera</u>	Gadwall	M-fc	-	-	-
	<u>Anas acuta</u>	Pintail	M-c	-	-	-

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TABLE 40 (Continued)

Family Name	Scientific Name	Common Name	1	2	3	4
<u>Anas</u>	<u>crecca</u>	Green-winged Teal	W-r	-	-	-
	<u>discors</u>	Blue-winged Teal	M-c	x	-	-
	<u>americana</u>	American Widgeon	M-c	-	1	-
	<u>clypeata</u>	Shoveler	M-fc	-	-	-
	<u>sponsa</u>	Wood Duck	P:S-fc, W-r	-	1	-
	<u>americana</u>	Redhead	M-uc	-	-	-
	<u>collaris</u>	Ring-necked Duck	M-c	-	-	-
	<u>valisineria</u>	Canvasback	W-uc	-	-	-
	<u>marila</u>	Greater Scaup	W-r	-	-	-
	<u>affinis</u>	Lesser Scaup	W-c	-	4	-
	<u>clangula</u>	Common Goldeneye	W-fc	-	-	-
	<u>albeola</u>	Bufflehead	W-fc	-	-	-
	<u>hyemalis</u>	Oldsquaw	W-r	-	1	-
	<u>deglandi</u>	White-winged Scoter	W-r	-	-	-
	<u>jamaicensis</u>	Ruddy Duck	W-r	-	-	-
	<u>cucullatus</u>	Hooded Merganser	P:W-uc, S-r	x	-	-
	<u>mergamser</u>	Common Merganser	W-uc	-	-	-
	<u>serrator</u>	Red-breasted Merganser	W-r	-	-	-
<u>Cathartidae</u>	<u>aura</u>	Turkey Vulture*	P:S-c, W-uc	x	1	-
	<u>atratus</u>	Black Vulture	P:S-fc, W-uc	x	-	-
<u>Accipitridae</u>	<u>mississippiensis</u>	Mississippi Kite	S-r	-	-	-
	<u>gentilis</u>	Goshawk	W-vr	-	-	x
	<u>striatus</u>	Sharp-shinned Hawk	P-r	x	-	x
	<u>cooperii</u>	Cooper's Hawk	P-uc	x	2	x
	<u>jamaicensis</u>	Red-tailed Hawk *	P:W-c, S-uc	x	5	x
	<u>lineatus</u>	Red-shouldered Hawk	P-fc	x	1	x
	<u>platypterus</u>	Broad-winged Hawk	S-uc	x	-	x
	<u>lagopus</u>	Rough-legged Hawk	W-r	-	-	x

TABLE 40 (Continued)

Family Name	Scientific Name	Common Name	1	2	3	4
	<u>Aquila chrysaetos</u>	Golden Eagle	W-vr	-	-	x
	<u>Haliaeetus leucocephalus</u>	Bald Eagle	P:W-r, S-vr	-	-	x
	<u>Circus cyaneus</u>	Marsh Hawk	P:W-uc, S-vr	x	1	x
Pandionidae	<u>Pandion haliaetus</u>	Osprey	P-vr	-	-	x
Falconidae	<u>Falco columbarius</u>	Pigeon Hawk	M-r	-	-	x
	<u>Falco sparverius</u>	Sparrow Hawk*	P:W-c, S-fc	x	4	x
Tetraonidae	<u>Bonasa umbellus</u>	Ruffed Grouse	P-uc	-	-	-
Phasianidae	<u>Colinus virginianus</u>	Bobwhite*	P-c	x	22	-
Meleagrididae	<u>Meleagris gallopavo</u>	Turkey	P-uc	x	-	-
Gruidae	<u>Grus canadensis</u>	Sandhill Crane	M-vr	-	-	-
Aramidae	<u>Rallus elegans</u>	King Rail	S-r	-	-	-
Rallidae	<u>Rallus limicola</u>	Virginia Rail	S-vr	-	-	-
	<u>Porzana carolina</u>	Sora	S-vr	-	-	-
	<u>Gallinula chloropus</u>	Common Gallinule	S-vr	x	-	-
	<u>Fulica americana</u>	American Coot	P:W-r, S-vr	-	-	-
Charadriidae	<u>Charadrius semipalmatus</u>	Semipalmated Plover	M-fc	-	-	-
	<u>Charadrius melodus</u>	Piping Plover	M-vr	-	-	-
	<u>Charadrius vociferus</u>	Killdeer*	P:S-c, W-fc	x	-	-
	<u>Pluvialis dominica</u>	American Golden Plover	M-r	-	-	-
	<u>Pluvialis squatarola</u>	Black-bellied Plover	M-r	-	-	-

TABLE 40 (Continued)

Family Name	Scientific Name	Common Name	1	2	3	4
Scolopacidae						
	<u>Arenaria interpres</u>	Ruddy Turnstone	M-r	-	-	-
	<u>Philohela minor</u>	American Woodcock*	P:S-r, W-vr	x	1	-
	<u>Capella gallinago</u>	Common Snipe	W-r	-	-	-
	<u>Bartramia longicauda</u>	Upland Plover	S-vr	x	-	-
	<u>Actitis macularia</u>	Spotted Sandpiper	S-r	x	-	-
	<u>Tringa solitaria</u>	Solitary Sandpiper	S-vr	-	-	-
	<u>Catoptrophorus semipalmatus</u>	Willet	S-vr	-	-	-
	<u>Tringa melanoleuca</u>	Greater Yellowlegs	S-vr	-	-	-
	<u>Tringa flavipes</u>	Lesser Yellowlegs	S-vr	-	-	-
	<u>Calidris canutus</u>	Knot	M-vr	-	-	-
	<u>Calidris melanotos</u>	Pectoral Sandpiper	N-c	-	-	-
	<u>Calidris fuscicollis</u>	White-rumped Sandpiper	M-vr	-	-	-
	<u>Calidris bairdii</u>	Baird's Sandpiper	M-r	-	-	-
	<u>Calidris alpina</u>	Dunlin	M-vr	-	-	-
	<u>Limnodromus griseus</u>	Short-billed Dowitcher	M-uc	-	-	-
	<u>Micropalama himantopus</u>	Stilt Sandpiper	M-uc	-	-	-
	<u>Calidris pusillus</u>	Semipalmated Sandpiper	M-c	-	-	-
	<u>Calidris mauri</u>	Western Sandpiper	M-uc	-	-	-
	<u>Tryngites subruficollis</u>	Buff-breasted Sandpiper	M-vr	-	-	-
	<u>Calidris alba</u>	Sanderling	M-uc	-	-	-
Phalaropodidae						
	<u>Steganopus tricolor</u>	Wilson's Phalarope	M-vr	-	-	-
Laridae						
	<u>Larus hyperboreus</u>	Glaucous Gull	W-vr	-	-	-
	<u>Larus argentatus</u>	Herring Gull	W-c	-	-	-
	<u>Larus delawarensis</u>	Ring-billed Gull	P:W-c, S-vr	-	-	-
	<u>Larus philadelphia</u>	Bonaparte's Gull	W-r	-	-	-
	<u>Sterna forsteri</u>	Forster's Tern	M-fc	-	-	-
	<u>Sterna hirundo</u>	Common Tern	M-r	-	-	-
	<u>Sterna albifrons</u>	Least Tern	S-uc	-	-	-
	<u>Hydroprogne caspia</u>	Caspian Tern	M-r	-	-	-

TABLE 40 (Continued)

Family Name	Scientific Name	Common Name	1	2	3	4
Columbidae	<u>Chlidonias niger</u>	Black Tern	S-vr	x	-	-
	<u>Columba livia</u>	Rock Dove*	P-c	-	-	-
	<u>Zenaidura macroura</u>	Mourning Dove*	P-c	x	63	-
Cuculidae						
	<u>Coccyzus americanus</u>	Yellow-billed Cuckoo*	S-c	x	-	-
	<u>Coccyzus erythrophthalmus</u>	Black-billed Cuckoo*	S-uc	-	-	-
Tytonidae						
	<u>Tyto alba</u>	Barn Owl	P-uc	x	-	x
Strigidae						
	<u>Otus asio</u>	Screech Owl	P-uc	x	-	x
	<u>Bubo virginianus</u>	Great Horned Owl	P-uc	x	-	x
	<u>Nyctea scandiaca</u>	Snowy Owl	W-vr	-	-	x
	<u>Strix varia</u>	Barred Owl*	P-fc	x	-	x
	<u>Asio otus</u>	Long-eared Owl	W-vr	-	-	x
	<u>Asio flammeus</u>	Short-eared Owl	W-uc	-	-	x
	<u>Aegolius acadicus</u>	Saw-whet Owl	W-vr	-	-	x
Caprimulgidae						
	<u>Caprimulgus carolinensis</u>	Chuck-will's Widow	S-fc	-	-	-
	<u>Caprimulgus vociferus</u>	Whip-poor-will*	S-c	x	-	-
	<u>Chordeiles minor</u>	Common Nighthawk	S-c	x	-	-
Apodidae						
	<u>Chaetura pelagica</u>	Chimney Swift*	S-c	x	-	-
Trochilidae						
	<u>Archilochus colubris</u>	Ruby-throated Hummingbird	S-c	x	-	-
Alcedinidae						
	<u>Megasceryle alcyon</u>	Belted Kingfisher*	P:S-c, W-fc	x	-	x
Picidae						
	<u>Colaptes auratus</u>	Common Flicker	P-c	x	10	-

TABLE 40 (Continued)

Family Name	Scientific Name	Common Name	1	2	3	4
	<u>Dryocopus pileatus</u>	Pileated Woodpecker	P-fc	x	1	-
	<u>Centurus carolinus</u>	Red-bellied Woodpecker*	P-c	x	6	-
	<u>Melanerpes erythrocephalus</u>	Red-headed Woodpecker	P:S-c, W-fc	x	-	-
	<u>Sphyrapicus varius</u>	Yellow-bellied Sapsucker	W-uc	x	1	-
	<u>Dendrocopos villosus</u>	Hairy Woodpecker	P-fc	x	-	-
	<u>Dendrocopos pubescens</u>	Downy Woodpecker	P-c	x	3	-
	<u>Tyrannidae</u>					
	<u>Tyrannus tyrannus</u>	Eastern Kingbird*	S-c	x	-	-
	<u>Myiarchus crinitus</u>	Great-crested Flycatcher	S-c	x	-	-
	<u>Sayornis phoebe</u>	Eastern Phoebe	P:S-c, W-r	x	-	-
	<u>Empidonax flaviventris</u>	Yellow-bellied Flycatcher	M-fc	-	-	-
	<u>Empidonax virens</u>	Acadian Flycatcher	S-fc	x	-	-
	<u>Empidonax traillii</u>	Willow Flycatcher	S-r	x	-	-
	<u>Empidonax minimus</u>	Least Flycatcher	M-fc	-	-	-
	<u>Contopus virens</u>	Eastern Wood Pewee*	S-c	x	-	-
	<u>Nuttallornis borealis</u>	Olive-sided Flycatcher	M-r	-	-	-
	<u>Alaudidae</u>					
	<u>Eremophila alpestris</u>	Horned Lark	P-c	x	60	-
	<u>Hirundinidae</u>					
	<u>Iridoprocne bicolor</u>	Tree Swallow	M-fc	-	-	-
	<u>Riparia riparia</u>	Bank Swallow	S-uc	x	-	-
	<u>Stelgidopteryx ruficollis</u>	Rough-winged Swallow	S-c	x	-	-
	<u>Hirundo rustica</u>	Barn Swallow*	S-c	x	-	-
	<u>Petrochelidon pyrrhonota</u>	Cliff Swallow	S-r	x	-	-
	<u>Progne subis</u>	Purple Martin*	S-c	x	-	-
	<u>Corvidae</u>					
	<u>Cyanocitta cristata</u>	Blue Jay*	P-c	x	24	-
	<u>Corvus brachyrhynchos</u>	Common Crow*	P-c	x	30	-
	<u>Paridae</u>					
	<u>Parus carolinensis</u>	Carolina Chickadee*	P-c	x	19	-

TABLE 40 (Continued)

Family Name	Scientific Name	Common Name	1	2	3	4
Sittidae	<u>Parus bicolor</u>	Tufted Titmouse*	P-c	x	31	-
	<u>Sitta carolinensis</u>	White-breasted Nuthatch*	P-c	x	-	-
	<u>Sitta canadensis</u>	Red-breasted Nuthatch	W-r	-	-	-
Certhiidae	<u>Certhia familiaris</u>	Brown Creeper	W-uc	-	1	-
Troglodytidae	<u>Troglodytes aedon</u>	House Wren	S-c	x	-	-
	<u>Troglodytes troglodytes</u>	Winter Wren	W-fc	-	2	-
	<u>Thryomanes bewickii</u>	Bewick's Wren	P-fc	x	-	-
	<u>Thryothorus ludovicianus</u>	Carolina Wren*	P-c	x	5	-
	<u>Telmatoodytes palustris</u>	Long-billed Marsh Wren	N-r	-	-	-
	<u>Cistothorus platensis</u>	Short-billed Marsh Wren	S-r	x	-	-
Mimidae	<u>Mimus polyglottos</u>	Mockingbird*	P-c	x	47	-
	<u>Dumetella carolinensis</u>	Catbird*	S-c	x	-	-
	<u>Toxostoma rufum</u>	Brown Thrasher	P:S-c, W-r	x	-	-
Turdidae	<u>Turdus migratorius</u>	American Robin*	P-c	x	-	-
	<u>Hylocichla ustelina</u>	Wood Thrush	S-c	x	-	-
	<u>Catharus guttatus</u>	Hermit Thrush	W-uc	-	-	-
	<u>Catharus ustulatus</u>	Swainson's Thrush	M-c	-	-	-
	<u>Catharus minimus</u>	Gray-cheeked Thrush	M-fc	-	-	-
	<u>Catharus fuscescens</u>	Veery	N-uc	-	-	-
	<u>Sialia sialis</u>	Eastern Bluebird	P-c	x	1	-
Sylviidae	<u>Polioptila caerulea</u>	Blue-gray Gnatcatcher*	S-c	x	-	-
	<u>Regulus satrapa</u>	Golden-crowned Kinglet	W-uc	-	-	-
	<u>Regulus calendula</u>	Ruby-crowned Kinglet	W-r	-	-	-

TABLE 40 (Continued)

Family Name Scientific Name	Common Name	1	2	3	4
Motacillidae					
<u>Anthus spinoletta</u>	Water Pipit	M-uc	-	-	-
Bombycillidae					
<u>Bombycilla cedrorum</u>	Cedar Waxwing	P-uc	x	-	-
Lanidae					
<u>Lanius ludovicianus</u>	Loggerhead Shrike*	P-fc	x	-	x
Sturnidae					
<u>Sturnus vulgaris</u>	Starling*	P-c	x	2 x 10 ⁶	-
Vireonidae					
<u>Vireo griseus</u>	White-eyed Vireo*	S-c	x	-	-
<u>Vireo bellii</u>	Bell's Vireo	M-r	-	-	-
<u>Vireo flavifrons</u>	Yellow-throated Vireo	S-fc	x	-	-
<u>Vireo solitarius</u>	Solitary Vireo	M-uc	-	-	-
<u>Vireo olivaceus</u>	Red-eyed Vireo*	S-c	x	-	-
<u>Vireo philadelphicus</u>	Philadelphia Vireo	M-uc	-	-	-
<u>Vireo gilvus</u>	Warbling Vireo	S-fc	x	-	-
Parulidae					
<u>Mniotilta varia</u>	Black-and-White Warbler	S-fc	x	-	-
<u>Protonotaria citrea</u>	Prothonotary Warbler	S-c	x	-	-
<u>Limothlypis swainsonii</u>	Swainson's Warbler	S-r	x	-	-
<u>Helminthos vermivorus</u>	Worm-eating Warbler	S-fc	x	-	-
<u>Vermivora chrysoptera</u>	Golden-winged Warbler	M-uc	-	-	-
<u>Vermivora pinus</u>	Blue-winged Warbler	S-uc	x	-	-
<u>Vermivora peregrina</u>	Tennessee Warbler	M-c	-	-	-
<u>Vermivora celata</u>	Orange-crowned Warbler	M-r	-	-	-
<u>Vermivora ruficapilla</u>	Nashville Warbler	M-fc	-	-	-
<u>Parula americana</u>	Northern Parula Warbler	S-fc	x	-	-
<u>Dendroica petechia</u>	Yellow Warbler	S-fc	x	-	-
<u>Dendroica magnolia</u>	Magnolia Warbler	M-c	-	-	-
<u>Dendroica tigrina</u>	Cape May Warbler	M-uc	-	-	-

TABLE 40 (Continued)

Family Name	Scientific Name	Common Name	1	2	3	4
	<u>Dendroica caerulescens</u>	Black-throated Blue Warbler	M-uc	-	-	-
	<u>Dendroica virens</u>	Black-throated Green Warbler	M-c	-	-	-
	<u>Dendroica cerulea</u>	Cerulean Warbler	S-fc	x	-	-
	<u>Dendroica fusca</u>	Blackburnian Warbler	M-uc	-	-	-
	<u>Dendroica dominica</u>	Yellow-throated Warbler	S-fc	-	-	-
	<u>Dendroica pensylvanica</u>	Chestnut-sided Warbler	M-fc	-	-	-
	<u>Dendroica castanea</u>	Bay-breasted Warbler	M-c	-	-	-
	<u>Dendroica striata</u>	Blackpoll Warbler	M-fc	-	-	-
	<u>Dendroica pinus</u>	Pine Warbler	S-c	x	-	-
	<u>Dendroica discolor</u>	Prairie Warbler	S-fc	x	-	-
	<u>Dendroica palmarum</u>	Palm Warbler	M-c	-	-	-
	<u>Seiurus aurocapillus</u>	Ovenbird	S-c	x	-	-
	<u>Seiurus noveboracensis</u>	Northern Waterthrush	M-fc	-	-	-
	<u>Seiurus motacilla</u>	Louisiana Waterthrush	S-fc	x	-	-
	<u>Oporornis formosus</u>	Kentucky Warbler*	S-c	x	-	-
	<u>Oporornis agilis</u>	Connecticut Warbler	M-r	-	-	-
	<u>Oporornis philadelphia</u>	Mourning Warbler	M-uc	-	-	-
	<u>Geothlypis trichas</u>	Common Yellowthroat*	S-c	x	-	-
	<u>Icteria virens</u>	Yellow-breasted Chat	S-c	x	-	-
	<u>Wilsonia citrina</u>	Hooded Warbler	S-fc	x	-	-
	<u>Wilsonia pusilla</u>	Wilson's Warbler	M-uc	-	-	-
	<u>Wilsonia canadensis</u>	Canada Warbler	M-uc	-	-	-
	<u>Setophaga ruticilla</u>	American Redstart	S-uc	x	-	-
Ploceidae	<u>Passer domesticus</u>	House Sparrow*	P-c	x	62	-
Icteridae	<u>Dolichonyx oryzivorus</u>	Bobolink	M-c	-	-	-
	<u>Sturnella magna</u>	Eastern Meadowlark*	P-c	x	46	-
	<u>Agelaius phoeniceus</u>	Red-winged Blackbird	P-c	x	2.5 x 10 ⁵	-
	<u>Icterus spurius</u>	Orchard Oriole*	S-c	x	-	-
	<u>Icterus galbula</u>	Northern Oriole*	S-fc	x	-	-

TABLE 40 (Continued)

Family Name	Scientific Name	Common Name	1	2	3	4
Thraupidae	<u>Euphagus carolinus</u>	Rusty Blackbird	W-r	-	2 x 10 ⁵	-
	<u>Euphagus cyanocephalus</u>	Brewer's Blackbird	W-vr	-	-	-
	<u>Quiscalus quiscula</u>	Common Grackle	P-c	x	-	-
	<u>Molothrus ater</u>	Brown-headed Cowbird*	P-c	x	2 x 10 ⁵	-
Piranga	<u>Piranga olivacea</u>	Scarlet Tanager	S-fc	x	-	-
	<u>Piranga rubra</u>	Summer Tanager	S-c	x	-	-
Fringillidae	<u>Cardinalis cardinalis</u>	Cardinal*	P-c	x	-	-
	<u>Phoebastria ludovicianus</u>	Rose-breasted Grosbeak	M-c	-	-	-
Passerina	<u>Guiraca caerulea</u>	Blue Grosbeak	S-r	x	-	-
	<u>Passerina cyanea</u>	Indigo Bunting*	S-c	x	-	-
Sparidae	<u>Spiza americana</u>	Dickcissel	S-c	x	-	-
	<u>Hesperiphona vespertina</u>	Evening Grosbeak	W-r	-	-	-
Carpodacus	<u>Carpodacus purpureus</u>	Purple Finch	W-fc	-	-	-
	<u>Acanthis flammea</u>	Common Redpoll	W-vr	-	-	-
Spinus	<u>Spinus pinus</u>	Pine Siskin	W-uc	-	-	-
	<u>Spinus tristis</u>	American Goldfinch*	P-c	x	17	-
Loxia	<u>Loxia curvirostra</u>	Red Crossbill	W-vr	-	-	-
	<u>Loxia leucoptera</u>	White-winged Crossbill	W-vr	-	-	-
Pipilo	<u>Pipilo erythrophthalmus</u>	Rufous-sided Towhee*	P-c	x	10	-
	<u>Passerculus sandwichensis</u>	Savannah Sparrow	P-vr	x	17	-
Ammodramus	<u>Ammodramus savannarum</u>	Grasshopper Sparrow*	S-c	x	-	-
	<u>Ammodramus lecontei</u>	LeConte's Sparrow	M-r	-	-	-
Poocetes	<u>Ammodramus henslowii</u>	Henslow's Sparrow	S-uc	x	-	-
	<u>Poocetes gramineus</u>	Vesper Sparrow	S-uc	x	-	-
Chondestes	<u>Chondestes grammacus</u>	Lark Sparrow	S-r	x	-	-
	<u>Chondestes aestivalis</u>	Bachman's Sparrow	S-uc	x	-	-
Junco	<u>Junco hyemalis</u>	Dark-eyed Junco }	W-c	-	84	-
		{ Oregon Junco	W-vr	-	-	-

TABLE 40 (Continued)

Family Name	Scientific Name	Common Name	1	2	3	4
<u>Spizella arborea</u>		Tree Sparrow	W-c	-	-	-
<u>Spizella passerina</u>		Chipping Sparrow*	S-c	x	-	-
<u>Spizella pusilla</u>		Field Sparrow*	P-c	x	25	-
<u>Zonotrichia querula</u>		Harris' Sparrow	W-vr	-	-	-
<u>Zonotrichia leucophrys</u>		White-crowned Sparrow	W-fc	-	9	-
<u>Zonotrichia albicollis</u>		White-throated Sparrow	W-c	-	-	-
<u>Passerella iliaca</u>		Fox Sparrow	W-uc	-	-	-
<u>Melospiza lincolni</u>		Lincoln's Sparrow	M-uc	-	-	-
<u>Melospiza georgiana</u>		Swamp Sparrow	W-fc	-	21	-
<u>Melospiza melodia</u>		Song Sparrow	P-c	x	70	-
<u>Calcarius lapponicus</u>		Lapland Longspur	W-r	-	-	-
<u>Plectrophenax nivalis</u>		Snow Bunting	W-vr	-	-	-

* Birds seen in the Big Muddy Creek Watershed in August, 1974.

- 1 - Resident status and abundance status according to Monroe (1969).
- P = Permanent Resident fc = Fairly Common
 S = Summer Resident uc = Uncommon
 W = Winter Resident r = Rare
 M = Migrant or Occasional Visitor vr = Very Rare
 c = Common
- 2 - Breeding birds according to Monroe (1969).
- 3 - 1973 Christmas bird count of the Bowling Green Audubon Club, Kentucky.
- 4 - Predatory birds (excluding insectivores).

TABLE 41

MAMMALS WHOSE RANGE INCLUDES THE BIG MUDDY CREEK WATERSHED
IN BUTLER AND LOGAN COUNTIES, KENTUCKY^a

Family Name <u>Scientific Name</u>	<u>Common Name</u>
Didelphiidae <u>Didelphis marsupialis</u> *	Opossum
Soricidae <u>Sorex logirostris</u> <u>Blarina brevicauda</u> <u>Cryptotis parva</u>	Southeastern Shrew Shorttail Shrew Least Shrew
Talpidae <u>Scalopus aquaticus</u>	Eastern Mole
Vespertilionidae <u>Myotis lucifugus</u> <u>Myotis austroriparius</u> <u>Myotis grisescens</u> <u>Myotis keenii</u> <u>Myotis sodalis</u> <u>Myotis leibii</u> <u>Lasionycteris noctivagans</u> <u>Pipistrellus subflavus</u> <u>Eptesicus fuscus</u> <u>Lasiurus borealis</u> <u>Lasiurus cinereus</u> <u>Nycticeius humeralis</u> <u>Plecotus rafinesquei</u>	Little Brown Bat Southeastern Myotis Gray Myotis Keen Myotis Indiana Myotis Small-footed Myotis Silver-haired Bat Eastern Pipistrel Big Brown Bat Red Bat Hoary Bat Evening Bat Eastern Big-eared Bat
Procyonidae <u>Procyon lotor</u> *	Raccoon
Mustelidae <u>Mustela frenata</u> <u>Mustela vison</u> <u>Lutra canadensis</u> <u>Spilogale putorius</u> <u>Mephitis mephitis</u>	Longtail Weasel Mink River Otter Eastern Spotted Skunk Striped Skunk
Canidae <u>Vulpes fulva</u> * <u>Urocyon cinereoargenteus</u>	Red Fox Gray Fox
Felidae <u>Lynx rufus</u>	Bobcat
Sciuridae <u>Marmota monax</u> <u>Tamias striatus</u> * <u>Sciurus carolinensis</u> <u>Sciurus niger</u> * <u>Glaucomys volans</u>	Woodchuck Eastern Chipmunk Eastern Gray Squirrel Eastern Fox Squirrel Southern Flying Squirrel

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TABLE 41 (Continued)

Family Name	Scientific Name	Common Name
Castoridae	<u>Castor canadensis</u>	Beaver
Cricetidae	<u>Reithrodontomys humulis</u>	Eastern Harvest Mouse
	<u>Peromyscus maniculatus</u>	Deer Mouse
	<u>Peromyscus leucopus</u> *	White-footed Mouse
	<u>Peromyscus gossypinus</u>	Cotton Mouse
	<u>Peromyscus nuttalli</u>	Golden Mouse
	<u>Oryzomys palustris</u>	Rice Rat
	<u>Microtus ochrogaster</u> *	Prairie Vole
	<u>Pitymys pinetorum</u>	Pine Vole
	<u>Ondatra zibethica</u> *	Muskrat
Zapodidae	<u>Zapus hudsonius</u>	Meadow Jumping Mouse
Leporidae	<u>Sylvilagus floridanus</u> *	Eastern Cottontail
Cervidae	<u>Odocoileus virginianus</u> *	Whitetail Deer

^aFrom Burt and Grossenheider (1964)

*Indicates observation

TABLE 42

REPTILES AND AMPHIBIANS WHOSE RANGE INCLUDES HABITATS OF
THE BIG MUDDY CREEK WATERSHED IN BUTLER AND LOGAN COUNTIES, KENTUCKY^a

Family Name	Scientific Name	Common Name
Chelydridae		
	<u>Chelydra serpentina</u> *	Snapping Turtle
	<u>Sternotherus odoratus</u>	Stinkpot
	<u>Kinosternon subrubrum</u>	Eastern Mud Turtle
	<u>Terrapene c. carolina</u> *	Eastern Box Turtle
	<u>Graptemys pseudogeographica</u> <u>ouachitensis</u>	Ouachita Map Turtle
	<u>Chrysemys picta picta</u>	Eastern Painted Turtle
	<u>Chrysemys picta marginata</u>	Midland Painted Turtle
	<u>Pseudemys scripta elegans</u>	Red-eared Turtle
Trionychidae		
	<u>Trionyx muticus</u>	Smooth Softshell
Iguanidae		
	<u>Sceloporus undulatus hyacinthinus</u> *	Northern Fence Lizard
Teiidae		
	<u>Cnemidophorus sexlineatus</u>	Six-lined Racerunner
Scincidae		
	<u>Lygosoma laterale</u>	Ground Skink
	<u>Eumeces fasciatus</u>	Five-lined Skink
	<u>Eumeces laticeps</u>	Broad-headed Skink
Colubridae		
	<u>Matrix sipedon sipedon</u>	Northern Water Snake
	<u>Storeria dekayi wrightorum</u>	Midland Brown Snake
	<u>Storeria o. occipitomaculata</u>	Northern Red-bellied Snake
	<u>Thamnophis sirtalis sirtalis</u>	Eastern Garter Snake
	<u>Thamnophis sauritus sauritus</u>	Eastern Ribbon Snake
	<u>Haldea valeriae</u>	Smooth Earth Snake
	<u>Heterodon platyrhinos</u>	Eastern Hognose Snake
	<u>Diadophis punctatus edwardsi</u>	Northern Ringneck Snake
	<u>Carphophis amoenus helenae</u>	Midwest Worm Snake
	<u>Coluber c. constrictor</u>	Northern Black Racer
	<u>Opheodrys aestivus</u> *	Rough Green Snake
	<u>Elaphe o. obsoleta</u>	Black Rat Snake
	<u>Lampropeltis getulus niger</u>	Black Kingsnake
	<u>Lampropeltis c. calligaster</u>	Prairie Kingsnake
	<u>Tantilla coronata coronata</u>	Southeastern Crowned Snake
Viperidae		
	<u>Agkistrodon contortrix mokeson</u>	Northern Copperhead
	<u>Crotalus horridus horridus</u>	Timber Rattlesnake

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TABLE 42 (Continued)

<u>Family Name</u> <u>Scientific Name</u>	<u>Common Name</u>
Cryptobranchidae	
<u>Cryptobranchus alleganiensis</u> <u>alleganiensis</u>	Hellbender
<u>Necturus maculosus</u>	Mudpuppy
Ambystomidae	
<u>Ambystoma texanum</u>	Small-Mouthed Salamander
<u>Ambystoma opacum</u>	Marbled Salamander
<u>Ambystoma maculatum</u>	Spotted Salamander
<u>Ambystoma tigrinum tigrinum</u>	Eastern Tiger Salamander
Salamandridae	
<u>Diemictylus viridescens viridescens</u>	Red-spotted Newt
Plethodontidae	
<u>Desmognathus fuscus fuscus</u>	Northern Dusky Salamander
<u>Eurycea bislineata bislineata</u>	Northern Two-lined Salamander
<u>Eurycea longicauda longicauda</u>	Long-tailed Salamander
Pelobatidae	
<u>Scaphiopus holbrookii</u>	Eastern Spadefoot
Bufonidae	
<u>Bufo americanus</u> *	American Toad
<u>Bufo woodhousei fowleri</u>	Fowler's Toad
Hylidae	
<u>Acris crepitans blanchardi</u>	Blanchard's Cricket Frog
<u>Hyla crucifer crucifer</u>	Northern Spring Peeper
<u>Hyla versicolor versicolor</u>	Eastern Gray Treefrog
<u>Pseudacris triseriata feriarum</u>	Upland Chorus Frog
Microhylidae	
<u>Gastrophryne carolinensis</u>	Eastern Narrow-mouthed Toad
Ranidae	
<u>Rana catesbeiana</u>	Bullfrog
<u>Rana clamitans melanota</u>	Green Frog
<u>Rana pipiens sphenoccephala</u>	Southern Leopard Frog
<u>Rana palustris</u>	Pickereel Frog

^a From Conant (1958)

*Indicates observation

TABLE 43
DESCRIPTION AND ACREAGE OF WETLAND TYPES IN THE UNITED STATES

<u>Wetland Category and Type</u>		<u>Water Depth^a</u>	<u>Total Acres</u>
Inland Fresh Areas:			
1. Seasonally flooded basins or flats	Few inches in upland; few feet along rivers		23,092,000
2. Inland fresh meadows	Few inches after heavy rains		7,518,000
3. Inland shallow fresh marshes	Up to 6 inches		3,969,000
4. Inland deep fresh marshes	Up to 3 feet		2,346,000
5. Inland open fresh water	Up to 10 feet; marshy border may be present		2,596,000
6. Shrub swamps	Up to 6 inches		3,813,000
7. Wooded swamps	Up to 1 foot		16,809,000
8. Bogs	Shallow ponds may be present		3,347,000

^aRefers to average conditions during growing season except for Type 1. In Type 1 bottomlands, flooding ordinarily occurs in late fall, winter, or spring. In Type 1 upland areas, depressions may be filled with water during heavy rain or melting snow, predominantly in early spring.

Source: Shaw and Fredline (1956).

TABLE 44

RELATIVE ABUNDANCE OF BIRDS IN THREE GENERAL HABITAT CATEGORIES ALONG THE FLOODPLAIN OF THE
BIG MUDDY CREEK WATERSHED, BUTLER AND LOGAN COUNTIES, KENTUCKY

Species	Bottomland Sampling Areas						Upland Habitats					
	Field (5, 6)		Edge (3, 5, 6)		Forest (1, 2, 4)		Forest		Edge		Field	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Green Heron			3		7							
Red-tailed Hawk	1	5	x									
Bobwhite	x		x		x	6	x		x		x	
Mourning Dove	1	5	x						x		x	
Yellow-billed Cuckoo			3		7							
Red-bellied Woodpecker						6						
Eastern Kingbird	1	5	x			1						
Eastern Wood Pewee									x		x	
Barn Swallow	11	52				3						
Blue Jay												
Carolina Chickadee			x			11						
Tufted Titmouse			2		4	10			x		x	
Carolina Wren	1	5	1		2	4			x			
Catbird			x			5			x			
Blue-gray Gnatcatcher			1		2	x			x			
White-eyed Vireo			3		7	4			x			
Kentucky Warbler			x			3			x			
Common Yellowthroat						1			x			
Eastern Meadowlark			x			1						
Baltimore Oriole	4	19							x			
Cardinal	x		x			1					x	
Indigo Bunting	x		4		9	12			x			
American Goldfinch			21		48	4			x		x	
Rufous-sided Towhee			3		7	2			x		x	
Field Sparrow	2	10	x			3			x			
Other Birds			1		2	4			x		x	
			2		4	5						

Sheet 1

TABLE 44 (Continued)

Species	Bottomland Sampling Areas						Upland Habitats					
	Field (5, 6)		Edge (3, 5, 6)		Forest (1, 2, 4)		Forest		Edge		Field	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
TOTAL BIRDS	21	101	44	99	86	96						
TRANSECT LENGTH (Feet)		4,950		5,720		4,400						
MEAN BIRDS/100 Feet		0.4		1.7		1.9						

x Birds will occur in the noted habitat.

TABLE 45

RARE AND ENDANGERED WILDLIFE

- I. Wildlife that are listed as rare or endangered by the Kentucky Fish and Wildlife Resources in the Kentucky Revised Statute 150.183 and that may occur in Butler and Logan Counties include the following:

Birds

<u>Aquila chrysaetos</u>	Golden eagle
<u>Haliaeetus leucocephalus alascanus</u>	Northern bald eagle
<u>Pandion haliaetus</u>	Osprey
<u>Grus canadensis</u>	Sandhill crane
<u>Ictinia mississippiensis</u>	Mississippi kite

Mammals

<u>Sorex longirostris</u>	Bachman's or southeastern shrew
<u>Myotis austroriparius</u>	Southeastern bat
<u>Myotis grisescens</u>	Gray bat
<u>Myotis leibii</u>	Small-footed myotis
<u>Spilogale putorius</u>	Spotted skunk

Amphibians and Reptiles

<u>Siren intermedia</u>	Western lesser siren
<u>Hemidactylium scutatum</u>	Four-toed salamander
<u>Thamnophis sauritus</u>	Eastern ribbon snake
<u>Lampropeltis calligaster</u>	Prairie king snake
<u>Cemophora coccinea</u>	Scarlet snake
<u>Tantilla coronata coronata</u>	Southeastern crowned snake

- II. Wildlife listed by the U.S. Department of Interior (1973) as threatened with extinction and possibly occurring in Kentucky include:

<u>Myotis sodalis</u>	Indiana myotis
<u>Haliaeetus leucocephalus leucocephalus</u>	Southern bald eagle
<u>Falco peregrinus anatum</u>	American peregrine falcon
<u>Dendrocopos borealis</u>	Red-cockaded woodpecker
<u>Dendroica kirtlandii</u>	Kirtland's warbler
<u>Vermivora bachmanii</u>	Bachman's warbler

TABLE 46

HUNTING SUCCESS ESTIMATED FROM 1.0 TO 1.9 PERCENT OF LICENSE HOLDERS DURING THREE HUNTING SEASONS IN BUTLER AND LOGAN COUNTIES, KENTUCKY^a

Species	Hunting Seasons					
	1961-1962			1962-1963		
	Total Harvest	Percent	Harvest per man	Total Harvest	Percent	Harvest per man
Gray Squirrel	26,623	30	11.7	26,934	28	10.8
Fox Squirrel	1,298	1		1,608	2	10.8
Cottontail Rabbit	16,232	18	8.0	20,679	22	10.8
Groundhog	1,452	2	2.5	2,346	2	7.9
Raccoon	5,286	6	10.2	6,314	6	12.0
Fox	415	1	0.8	760	1	1.8
Bobwhite	29,337	32	21.0	28,714	30	16.5
Mourning Dove	8,439	9	9.0	6,050	6	6.8
Crow	207	0	1.3	360	0	--
Woodcock	0	0	0.0	174	0	--
TOTAL	89,289	99		93,939	97	
				88,395	100	

^a From Kentucky Department of Fish and Wildlife Resources, 1971.

TABLE 47
RELATIVE ABUNDANCE AND LENGTH RANGE OF FISHES COLLECTED AT FOUR STATIONS IN THE BIG MUDDY CREEK DRAINAGE,
BUTLER AND LUCAN COUNTIES, KENTUCKY DURING AUGUST 1974

Family	Species	Station 1				Station 2				Station 3				Station 4			
		No.	Length	No.	Length	No.	Length	No.	Length	No.	Length	No.	Length	No.	Length	No.	Length
Clupeidae ^b	<i>Brevoortia cepedianum</i>	4	(107)	78-125	13	(147)	110-236	2	(160)	140-180	-	-	-	-	-	-	-
Eucidae	<i>Esox americanus</i>	-	-	-	7	(80)	68-90	1	(221)	-	-	-	-	-	-	-	-
Cyprinidae	<i>Stoneroller</i>	-	-	-	-	-	-	-	-	-	-	-	-	16	(46)	35-140	-
	<i>Golden shiner</i>	-	-	-	-	-	-	-	-	-	-	-	-	1	(115)	-	-
	<i>Emerald shiner</i>	-	-	-	12	(61)	32-77	3	(38)	35-39	-	-	-	16	(36)	18-52	-
	<i>Common shiner</i>	-	-	-	-	-	-	-	-	-	-	-	-	7	(163)	120-170	-
	<i>Pumpkin minnow</i>	2	(25)	24-26	-	-	-	-	-	-	-	-	-	25	(87)	56-108	-
	<i>Bluntnose minnow</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>Bullhead minnow</i>	22	(40)	24-64	14	(37)	25-46	-	-	-	-	-	-	35	(53)	25-73	-
	<i>Creek chub</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>Creek chubsucker</i>	-	-	-	-	-	-	-	-	-	-	-	-	62	(50)	35-152	-
Catostomidae	<i>Creek chubsucker</i>	-	-	-	-	-	-	-	-	-	-	-	-	6	(22)	40-104	-
	<i>Spotted sucker</i>	1	(218)	-	-	-	-	-	-	3	(269)	262-275	-	-	-	-	-
	<i>Golden redbreast</i>	9	(165)	49-122	5	(107)	44-345	1	(120)	-	-	-	-	1	(71)	-	-
Ictaluridae	<i>Yellow perch</i>	-	-	-	-	-	-	-	-	17	(120)	54-180	10	(45)	31-135	-	-
	<i>Channel catfish</i>	14	(131)	44-251	-	-	-	-	-	-	-	-	-	-	-	-	-
	<i>Tadpole matfish</i>	3	(28)	24-32	1	(64)	32-80	-	-	-	-	-	-	-	-	-	-
Atherinidae	<i>Pirate perch</i>	1	(31)	-	-	-	46-61	-	-	-	-	-	-	1	(65)	-	-
Cyprinodontidae	<i>Blackstripe killifish</i>	-	-	-	-	4	(34)	33-34	-	-	-	-	-	1	(20)	-	-
Poeciliidae	<i>Bluegill</i>	4	(35)	33-35	-	-	-	-	-	-	-	-	-	-	-	-	-
Atherinidae	<i>Bluegill</i>	4	(35)	33-35	-	-	-	-	-	-	-	-	-	-	-	-	-
Atherinidae	<i>Brook silverside</i>	1	(43)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Centrarchidae	<i>Flower</i>	-	-	-	-	-	-	-	-	1	(146)	-	-	-	-	-	-
	<i>Green sunfish</i>	-	-	-	-	-	-	-	-	6	(85)	59-108	10	(95)	63-165	-	-
	<i>Mudminnow</i>	4	(68)	58-85	17	(83)	58-140	-	-	11	(114)	63-168	-	-	-	-	-
	<i>Bluegill</i>	35	(61)	24-115	35	(61)	29-125	26	(101)	24-142	-	-	-	-	-	-	-
	<i>Longear sunfish</i>	16	(68)	54-125	21	(61)	40-113	65	(105)	57-145	14	(71)	23-110	-	-	-	-
	<i>Largemouth bass</i>	-	-	-	1	(26)	-	-	-	1	(201)	-	-	-	-	-	-
	<i>White crappie</i>	2	(111)	88-133	2	(129)	118-140	4	(143)	110-186	-	-	-	-	-	-	-
Percidae	<i>Spottail darter</i>	10	(60)	31-62	16	(34)	27-72	3	(39)	37-41	29	(31)	21-55	-	-	-	-
	<i>Blacktail darter</i>	4	(67)	47-52	8	(61)	42-50	9	(62)	51-79	-	-	-	-	-	-	-
Sciaenidae	<i>Crashout drum</i>	3	(226)	216-227	-	-	-	-	-	1	(146)	-	-	-	-	-	-
Cottidae	<i>Banded aculpin</i>	-	-	-	-	-	-	-	-	-	-	-	-	2	(73)	68-78	-

^atotal length range (mm) with mean length in parentheses.

^bknown future from American Fisheries Society, 1970.

TABLE 48

TOTAL FISH BIOMASS AND COMPOSITION BY FAMILY AT FOUR LOCATIONS IN THE
BIG MUDDY CREEK DRAINAGE, BUTLER AND LOGAN COUNTIES, KENTUCKY, AUGUST 1974

Family Name	Common Name	Station 1		Station 2		Station 3		Station 4	
		Lb/Acre	Percent	Lb/Acre	Percent	Lb/Acre	Percent	Lb/Acre ^a	Percent
Clupeidae	Herrings	0.5	1.8	3.0	29.1	1.0	2.0	-	-
Esocidae	Pikes	-	-	^b	-	0.8	1.7	-	-
Catostomidae	Suckers	14.7	49.3	3.0	29.1	6.4	12.4	-	3.1
Ictaluridae ^c	Catfishes	4.7	15.8	-	-	4.1	7.9	-	4.4
Centrarchidae	Sunfishes	4.4	14.6	3.5	33.4	30.3	58.9	-	10.5
Sciaenidae	Drums	5.1	17.0	-	-	6.3	12.1	-	-
Other ^d		0.5	1.5	0.9	8.4	2.6	5.0	-	8.2
Sample area or effort		0.03 acres		0.05 acres		0.04 acres		1665 seconds	
Total lb/acre		29.9	100	10.5	100	51.5	100	-	100

^a Sample qualitative, biomass not calculated.

^b Included in "Other" because too small to weigh.

^c Excludes the tadpole madtom.

^d Includes minnows, topminnows, shiners, etc.

TABLE 49

INVENTORY OF RECREATIONAL FACILITIES,
BUTLER AND LOGAN COUNTIES, 1974

<u>Facility</u>	<u>Ownership</u>	<u>Total Acreage</u>	<u>Comment</u>
BUTLER COUNTY			
County High School	City/Co.	45 ^a	
Morgantown Elementary	City/Co.		
3rd District Elementary	City Co.	10	
4th District Elementary	City/Co.	10	
5th District Elementary	City/Co.	10	
County Fairgrounds	County	25	
Civil War Site (Court House)	Private	-	Historical Site
Civil War Site (Rt. 403)	Private	-	Historical Site
Lock and Dam #4	Federal	8	
LOGAN COUNTY			
Adairville Elementary & H.S.	County	-	
Auburn Elementary & H.S.	County	-	
Chandlers Elementary & H.S.	County	-	
Lewisburg Elementary & H.S.	County	-	
Olmstead Elementary & H.S.	County	-	
Logan Elementary	County	6	
Stevenson Elementary	City	24	
Russellville High School	City	25	
Russellville Middle	City	3	
Sacred Heart Elementary	Private	1	
Shakertown	^b	N/A	
County Fairgrounds	^c	45	
City Square	City	1	
City Memorial Park	City	80	
Wildcat Hollow Boy Scout Camp	Private	1200	
Lake Malone State Resort	State	1135 ^d	
Russellville County Club	Private	N/A	9 Holes
Breathitt House	Private	N/A	Historical Site
Clark House	Private	N/A	Historical Site
Crittenden House	Private	N/A	Historical Site
Governor Morehead House	Private	N/A	Historical Site
Red River Church	Private	N/A	Historical Site
Southern Bank	Private	N/A	Historical Site
Savage (Cook's) Site	Private	N/A	Historical Site
McCutchen-Coke Park (Auburn)	City	12	Community Park (BOR \$)
Hampton Park (Russellville)	City	4	Playground (BOR \$)

^a - counted with county high school acreage^b - leased from state^c - owned by American Legion^d - not all in BRADD

Source: BRADD, 1974.

TABLE 50

RECREATION NEEDS, BY ACTIVITY, BRADD

	<u>1970</u>		<u>1980</u>		<u>1990</u>	
	<u>Length</u>	<u>Prime</u>	<u>Length</u>	<u>Prime</u>	<u>Length</u>	<u>Prime</u>
	<u>Season</u>	<u>Season</u>	<u>Season</u>	<u>Season</u>	<u>Season</u>	<u>Season</u>
CAMPING						
Units (Sites)	0	0	76	213	294	496
Land (Acres)	0	0	54	152	210	354
Costs (Thousands)						
Acquisition	0	0	12	33	45	76
Development	0	0	243	682	941	1587
Total Cost	0	0	255	715	986	1663
PICNICKING						
Units (Tables)	0	0	0	0	0	159
Land (Acres)	0	0	0	0	0	218
Costs (Thousands)						
Acquisition	0	0	0	0	0	47
Development	0	0	0	0	0	80
Total Cost	0	0	0	0	0	127
GOLF						
Units (Holes)	26	93	102	200	209	348
Land (Acres)	216	772	847	1660	1735	2888
Costs (Thousands)						
Acquisition	47	166	182	357	373	621
Development	520	1860	2040	4000	4180	6960
Total Cost	567	2026	2222	4357	4553	7581
TENNIS						
Units (Courts)	0	0	0	0	0	0
Land (Acres)	0	0	0	0	0	0
Costs (Thousands)						
Acquisition	0	0	0	0	0	0
Development	0	0	0	0	0	0
Total Cost	0	0	0	0	0	0
SWIMMING						
Units (Pools	3	2	18	17	38	36
Land (Sq. Ft.)	12,248	9,035	88,652	83,985	188,049	181,492
Costs (Thousands)						
Acquisition	0.3	0.2	2	2	4	4
Development	375.0	250.0	2,250	2,125	4,750	4,500
Total Cost	375.3	250.2	2,252	2,127	4,754	4,504

Sheet 1

TABLE 50 (Continued)

	<u>1970</u>		<u>1980</u>		<u>1990</u>	
	<u>Length</u>	<u>Prime</u>	<u>Length</u>	<u>Prime</u>	<u>Length</u>	<u>Prime</u>
FISHING						
Water (Acres)	0	0	0	0	3,752	927
Costs (Thousands)						
Acquisition	0	0	0	0	807	199
Development	0	0	0	0	750	185
Total Cost	0	0	0	0	1,557	384
WATER SKIING						
Water (Acres)	0	0	0	0	a	1,791
Costs (Thousands)						
Acquisition	0	0	0	0	a	385
Development	0	0	0	0	a	358
Total Cost	0	0	0	0		743
POWER BOATING						
Water (Acres)	0	0	0	0	a	943
Costs (Thousands)						
Acquisition	0	0	0	0	a	203
Development	0	0	0	0	a	188
Total Cost	0	0	0	0		391
SAILING						
Water (Acres)	0	0	0	0	a	86
Costs (Thousands)						
Acquisition	0	0	0	0	a	19
Development	0	0	0	0	a	17
Total Cost	0	0	0	0		36
OUTDOOR GAMES						
Land (Acres)	51	N/A	92	N/A	149	N/A
Costs (Thousands)						
Acquisition	11	N/A	20	N/A	32	N/A
Development	152	N/A	276	N/A	446	N/A
Total Cost	163		296		478	

TABLE 50 (Continued)

	<u>1970</u>		<u>1980</u>		<u>1990</u>	
	<u>Length</u>	<u>Prime</u>	<u>Length</u>	<u>Prime</u>	<u>Length</u>	<u>Prime</u>
BICYCLING						
Land (Miles)	22	18	26	21	32	26
Costs (Thousands)						
Acquisition	5	4	6	5	7	6
Development	348	284	411	332	506	411
Total Cost	353	288	417	337	513	417
HIKING						
Land (Miles)	0	0	0	0	7	7
Costs (Thousands)						
Acquisition	0	0	0	0	2	2
Development	0	0	0	0	37	37
Total Cost	0	0	0	0	39	39
HORSEBACK RIDING						
Land (Miles)	11	2	19	8	30	15
Costs (Thousands)						
Acquisition	2	0.4	4	2	7	3
Development	174	320	300	126	474	237
Total Cost	176	32.4	304	128	481	240
HUNTING						
Land (Acres)	16,027	13,078	23,042	18,924	35,111	28,981
Costs (Thousands)						
Acquisition	3,448	2,814	4,957	4,071	7,553	6,235
Development	N/A	N/A	N/A	N/A	N/A	N/A
Total Cost	3,448	2,814	4,957	4,071	7,553	6,235
CANOEING						
Water(Miles)	4	4	5	5	6	6
Costs (Thousands)						
Acquisition	N/A	N/A	N/A	N/A	N/A	N/A
Development	N/A	N/A	N/A	N/A	N/A	N/A

N/A - Not applicable or not available.

^aThe needs of the four water-based activities (fishing, water skiing, power boating and sailing) have the same length of season information for the projection year. They are not additive, and are shown as one need under "fishing." However, the prime season and peaking needs for these four activities are additive.

Sheet 3

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GLOSSARY

1. Accelerated land treatment program - increased rate of planning and applying conservation treatment programs, usually brought about by additional technical and cost-sharing assistance to land users.
2. Channel modification - the modification of the flow characteristics of a channel by clearing, excavation, realignment, lining, or other means, in order to increase its capacity.
3. Conservation land treatment program - a program for the planning and application of systems of conservation measures that result in the protection, enhancement, and use of the soil and water resource base.
4. Design storm - a given rainfall amount, with areal and time distribution, and duration used to estimate surface water runoff, usually expressed in terms of frequency (5-year, 10-year, etc.).
5. Emergency spillway - a rock or vegetated earth waterway around a dam, used to convey extreme amounts of water runoff safely past the dam.

6. Ephemeral stream - a stream or portion of stream that flows only in direct response to precipitation. Its channel is at all times above the water table.
7. Floodwater retarding structure - a dam, usually with an earth-fill, across a valley built for the temporary storage of floodwater. It is designed to release this flood storage at a predetermined rate.
8. Frequency (flood) - a process of using statistical methods to predict or measure the magnitude of floodflows.
9. Intermittent stream - carries water most of the time, but ceases to flow occasionally because evaporation and seepage into its bed and banks exceed inflow.
10. Land treatment measures - construction and management-type practice normally planned, installed, and maintained by individuals or groups of landowners on their own lands to efficiently use and protect the land and water resources. Measures serve to reduce runoff, erosion, and sediment that would restrict land use, adversely affect the environment, and reduce the realization of maximum benefits from other existing and proposed measures.
11. Levee (dike) - an embankment for preventing the overflow of a stream.

12. Man's environment - the sum total of all the external conditions that act upon man to influence his development or existence.
13. Multiple-purpose structure - a dam across a valley built to store water for two or more purposes. Purposes may include temporary flood storage and additional storage for municipal water, recreation, fish and wildlife, irrigation, and water quality improvement.
14. Ongoing land treatment program - the existing rate of planning and applying land treatment programs by individuals and groups.
15. Principal spillway - a concrete or metal pipe or conduit through a dam, for the purpose of conveying all ordinary discharges going out of a reservoir in a safe and non-erosive manner.
16. Sediment pool - the area in a floodwater retarding structure or a multiple-purpose structure allocated for sediment deposition. The size of the sediment pool is based upon the amount of sediment expected during the life of the structure, usually 50 years.

17. Soil capability classes - capability grouping showing, in a general way, the suitability of soils for most kinds of crops.

The groups are made according to the limitations of the soils when used for crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive land-forming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to specialty crops requiring special management.

- | | | |
|-------|-------|--|
| CLASS | I - | Soils that have few limitations that restrict their use. |
| CLASS | II - | Soils that have moderate limitations that reduce the choice of plants or that require moderate conservation practices. |
| CLASS | III - | Soils that have severe limitations that reduce the choice of plants, require special conservation practices, or both. |
| CLASS | IV - | Soils that have very severe limitations that reduce the choice of plants, require very careful management, or both. |
| CLASS | V - | Soils that are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife. |
| CLASS | VI - | Soils that have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture or range, woodland, or wildlife. |
| CLASS | VII - | Soils that have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture or range, woodland, or wildlife. |

CLASS VIII - Soils and landforms having limitations
 that preclude their use for commercial plants
 and restrict their use to recreation, wildlife,
 or water supply, or to esthetic purposes.

19. Unmodified channel (natural) - a channel as it was formed by
nature. It has not been altered to any extent by man's
activities.

STRUCTURE DATA, CHANNELS FOR FLOOD PREVENTION,
BIG MUDDY CREEK WATERSHED, KENTUCKY

Channel Designation	Station No. for Reach		Watershed Area ^a (sq mi)	Planned Channel Capacity (cfs)	Average Bottom Width (ft)	Average Side Slope	Average Depth (ft)	Average Grade (pct)	Average Channel Velocity (ft/sec)	Volume of Excavation (1000 cu yd)
	Station (100 ft)	Station (100 ft)								
Pt. A to B	127	163	7.42	1354	28	2:1	7.6	.088	4.52	15.4
	163	205	8.08	1472	30	2:1	7.7	.088	4.60	23.7
Pt. B to C	205	235	10.79	1807	40	2:1	7.5	.088	4.70	20.2
Pt. C to G	235	291	11.33	1936	60	2:1	4.9 ^g	.093	4.61	53.8
Pt. D to E	144	169	3.88	665	18	2:1	7.5	.081	3.03	2.8
Pt. E to F	169	223.5	6.14	963	20	2:1	7.5	.081	4.11	12.0
Pt. F to G	223.5	291	10.02	1199	28	2:1	7.0 ^h	.093	4.45	28.0
Pt. G to H	291	316	21.68	3500	60	2:1	9.0 ^h	.048	4.48	55.6
Pt. H to I	316	382	27.14	3950	70	2:1	8.8 ^h	.048	4.53	167.4
Pt. I to J	382	419	27.28	3950	70	2:1	8.8 ^h	.048	4.53	91.2
Pt. J to K	419	494	37.39	4301	70	2:1	8.5 ^h	.063	5.10	160.8
Pt. K to L	494	551	41.59	5110	70	2:1	10.1 ^h	.054	5.11	149.9
Pt. L to M ^{b,c}	551	634	43.93	5133	70	2:1	9.3 ^h	.030	4.55	246.9
Pt. M to N ^{b,d}	634	670	53.81	6223	70	2:1	12.3	.030	4.74	108.3
Pt. N to O ^{b,e}	670	713	57.05	6223	70	2:1	12.3	.030	4.74	135.0
Pt. O to P ^{b,f}	713	773	59.43	6227	80	2:1	8.0	.022	4.78	138.3
Pt. P to Q	773	902	62.23	-	-	2:1	-	-	-	64.3

^aUncontrolled area at end of reach.

^bPreliminary design is for channel with dikes; dike side slopes: 2:1 inside, 3:1 outside, berm width 12 ft. Average dike height: ^c4 ft; ^d4 ft; ^e4 1/2 ft; ^f8 ft. Additional depth for V-bottom: ^g3 ft; ^h4 ft.

APPENDIX G



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